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ACCUMULATED FERTILITY IN
GRASS LAND IN CONSEQUENCE OF
PHOSPHATIC MANURING:
Second Report on Experiments.

W. SOMERVILLE, M.A., D.Sc.,

Sibthorpiam Professor of Rural Economy in the University of Oxford.

THE issue of this *Journal* for September, 1914, contained a short account of some experiments conducted at Oxford with the view of ascertaining to what extent fertility is accumulated in grass land that has been treated with phosphates, such as basic slag. At that time only a single crop (oats) had been grown, but figures dealing in addition with three crops of mustard and a crop of wheat are now available, so that there are now much more ample data on which to base conclusions.

The problem may be briefly restated. A farmer dresses his grass land with a phosphatic manure, and he finds that, as a consequence, it can not only carry more stock but that each individual animal thrives better, making more bone and muscle, producing more fat, or giving more milk, as the case may be. By periodically weighing the animals the amount, for instance, of live-weight increase obtained per acre can be ascertained, and the result leaves no room for doubt that in the great majority of cases such treatment of grass land yields a satisfactory, often a very large, profit to the farmer.

Apart from the indirect effect on the stock the immediate and visible result is that clover, trefoil, kidney vetch, and leguminous plants generally, become more abundant and more vigorous, and as it is known that this class of plant fixes nitrogen from the air and stores it up in the soil in the form of humus, one would expect that such land would thereby be improved in fertility. Apart, however, from the special power of leguminous plants to add to fertility, the mere accumulation of vegetable matter by the growth of grasses must add to the productive capacity of

the soil. Such fertility, whether accumulated by leguminous or by non-leguminous vegetation, reacts upon the plants occupying the grass land, so that the effects of phosphates on the herbage are both direct and indirect.

So long as the pasture or meadow is left in grass it is a difficult matter to estimate the amount of this storage of fertility, but if the field were to be put under the plough the accumulation of fertility would cease; and not only so, but what has been stored up would be decomposed, and its plant food liberated. This aspect of the case is of special significance at the present time when the breaking up of pasture is being advocated in many quarters. It is possible, too, that after the war, economic and social considerations may result in an increase of the tillage area. In any event, it is a matter of some importance to ascertain to what extent the use of phosphates on grass land is likely to react on the cropping power of such land when converted to arable cultivation.

Method Employed in the Experiments.—The method employed in these experiments was to take supplies of soil, with the corresponding amount of turf, to a depth of about 9 in., and to place them in flower pots in which plants (oats, wheat, mustard) could be grown. The usual precautions as regards seed, number of plants per pot, watering, etc., were taken, and, on the whole, the work has proceeded with satisfactory freedom from disturbance. Soil from five centres was obtained, 10 pots being concerned with each centre. Five of the pots of each series were filled with soil that had been "treated" with basic slag, once or oftener, during previous years; while 5 pots were filled with soil from a part of the same field that had been left "untreated" with slag. The terms "treated" and "untreated" will be used in the following report in the sense just explained. Oats were grown in 1914, followed by two mustard crops in the same year. Wheat was sown in the autumn of 1914 and cut in July, 1915, after which another crop of mustard was taken.

Up to February, 1914, when the pot experiments were started, the fields at the five centres had been treated as follows:—

Denton Hill, Newhaven, Sussex: thin soil over chalk. Had been under very poor grass for about 8 years. Was dressed with basic slag at the rate of 7 cwt. per acre in March, 1911. The phenomenal drought of that year prevented any action during the first season, but in 1912 and 1913 the effects of the slag were very distinct. Grazed in 1911, cut for hay in 1912 and 1913.

Cockle Park, Northumberland: strong boulder clay, down to poor grass for many years. The "untreated" soil was taken from plot 6, while the "treated" was from plot 3. The latter

plot received 10 cwt. of basic slag per acre for 1897, 1906 and 1912, and the outlay has been repaid many times over.*

Stoke Talmage, Tetsworth, Oxon: heavy loam on Gault clay. Has been under grass for many years. The "treated" part of the field got 5 cwt. per acre of basic slag for 1910 and 1911. This dressing increased the yield of hay in 1910, 1911 and 1912 by 31 per cent.

Arncot, Bicester, Oxon: Oxford clay, rather wet, carrying inferior herbage. The "treated" portion of the field received 5 cwt. per acre of basic slag for 1909, 1910 and 1911. The field was grazed in 1910, 1912 and 1913, while a crop of hay was taken in 1909 and 1911. The slag increased the yield of hay by 50 per cent.

Lees Rest, Charlbury, Oxon: limestone brash on Great Oolite. Received 5 cwt. of basic slag per acre for 1910. This produced a striking effect on the herbage, which has been grazed each year.

Something went wrong with the oat plants (1914) in two of the pots filled with Arncot soil, so that the figures for this crop in the Arncot series have been rejected. The other 4 crops in this series, however, grew normally and have yielded reliable figures.

In the case of the oats and wheat 20 and 10 seeds respectively were sown in each pot, and, when well established, the plants were thinned down so that each pot had the same number (7 oats, 9 wheat). The mustard seed was supplied to each pot by measure.

While both "total weight" and "grain" were separately determined for the cereals, the figures for the former are alone dealt with in this report. The conclusions to which a consideration of the results leads would have been precisely the same had the "grain" figures been taken for discussion.

Experimental Error.—If experimental results are to be of any value they must be reliable. It is therefore desirable, in the first place, to test the fluctuations in yield that occur between sets of pots receiving exactly the same treatment. Such a test is afforded by comparing the yields of the first and second pots of each series. These pots were filled with "untreated" soil, and nothing was subsequently added but water. The total yield of the five crops† of the five series was 415.8 grammes for the first pot, and 419.0 grammes for the second pot, or as 100 is to 100.8 (see Table I.). This represents an experimental error of less than 1 per cent. Another similar test can be applied by

* See *Supplement to the Journal of the Board of Agriculture*, January, 1911.

† Four crops at Arncot, as explained above.

comparing the yields of the first and second pots of the "treated" soil of each series, as is done in the same Table. These pots were filled with "treated" soil and subsequently received nothing but water. The total yield of the five crops* of the five series was 525·5 grammes for the first pot, and 536·4 grammes for the second pot, or as 100 is to 102·1. Here the limit of error is just over 2 per cent. Apparently, therefore, when "treated" and "untreated" yields are compared, differences exceeding 2 per cent. may be considered as due to "treatment." In point of fact the limits of error are even narrower, because whereas this 2 per cent. variation applies to comparisons of 48 weighings, the comparison between "treated" and "untreated" results is never based on less than 98 weighings, and may be based on as many as 248. The detailed figures are set out in tabular form in Table I.

When the figures for only one centre are compared the limits of error are, of course, wider, because here we are comparing yields from only 5 crops grown successively in any one pot. When, however, "treated" and "untreated" results for a single centre are compared, we have comparisons, in one case, of 10 yields, and in another of 25, which, as above explained, reduces the limits of error.

TABLE I.

	Yields of the "untreated" soil.		Yields of the "treated" soil.	
	1st Pot. Grammes.	2nd Pot. Grammes.	1st Pot. Grammes.	2nd Pot. Grammes.
Denton Hill ..	79·5 as 100	81·3 is to 102·3	94·7 as 100	96·9 is to 102·3
Cockle Park ..	73·0 as 100	73·4 is to 100·5	125·9 as 100	122·7 is to 97·5
Stoke Talmage ..	93·7 as 100	102·4 is to 109·3	93·4 as 100	107·5 is to 115·1
Arncot	78·1 as 100	80·1 is to 102·6	125·7 as 100	123·7 is to 98·4
Lees Rest ..	94·5 as 100	81·8 is to 89·4	85·8 as 100	85·6 is to 99·8
Total	415·8 as 100	419·0 is to 100·8	525·5 as 100	536·4 is to 102·1

As will be seen, the limits of error are under 3 per cent. for Denton Hill, Cockle Park, and Arncot, while for Stoke Talmage and Lees Rest they run up to 15·1 and 10·6 per cent. respectively. In point of fact the detailed figures from these two centres are not of much interest, for the reason that there is neither cultural nor chemical evidence that fertility has been appreciably accumulated at either.

* Four crops Arncot.

What Amount of Fertility has been Stored up?—The experiments were so arranged as to furnish two answers to this question. The first two pots of each series were filled with "untreated" soil, while the sixth and seventh were filled with "treated" soil. In other respects the pots were all managed alike. The results are shown in Table II.

In each of the five series of soils there is a marked increase in the oats, but as regards the other four crops that follow there is a consistent increase only at Denton Hill, Cockle Park, and Arncot (see illustrations). On the aggregate of the five crops, the fertility stored up by the use of 7 cwt. per acre of basic slag at Denton Hill in 1911 has produced an increase of 19 per cent., the corresponding figures for 30 cwt. of slag at Cockle Park being 70 per cent. and for 15 cwt. of slag at Arncot (4 crops) 58 per cent. The total yield of the five "untreated" soils is 834·8 grammes, while that of the five "treated" soils is 1061·9 grammes, the increase thus averaging 27 per cent.

By comparing the last 3 pots of the "untreated" soil in each series with the last 3 pots of the "treated" soil, we get a further answer to the question. Each of these 3 pots got direct manuring, but as it was precisely the same in each set of pots it may for the present be disregarded and attention confined to the question of residual fertility. The detailed figures are set out in Table III.

Where manure has been used directly, as it was in all these pots, the fertility stored up in the grass land has not had quite so full an opportunity of producing its effects, with the result that, on the whole, the percentage increase in the "treated" plots, as shown in Table III, is rather less than where no manure was directly applied to the pots (Table II.). In the aggregate the yield of these five "untreated" soils is 1329·0 grammes, while that of the five "treated" soils is 1612·6 grammes, or an average increase of 21 per cent.

As was to be expected, the storage of fertility has been greatest in the case of the pasture which has been subjected to treatment with basic slag over the longest period, though the quantity of slag used has no doubt also had a determining effect. The soil from Cockle Park, which has had 10 cwt. of basic slag per acre for 1897, 1906 and 1912—30 cwt. in all in 17 years, up to the spring of 1914 when the samples were taken—has given increases of 50 and 70 per cent. as compared with "untreated" soil. Arncot, getting 5 cwt. per acre of basic slag in 1909, 1910 and 1911—15 cwt. in all in 4 years up to the spring of 1914—has produced increases of 45 and 58 per cent. Denton Hill, which got a single dressing of 7 cwt. per acre of basic

slag for 1911, has given increases of 8 and 19 per cent. Stoke Talmage and Lees Rest, getting respectively 10 and 5 cwt. per acre of slag, have shown but little, if any, accumulation of residual fertility, a result perhaps due in part to the unsuitability of these soils for the growth of mustard. If the cereals alone are considered there is marked evidence of the accumulation of fertility in seven of the eight tests applied to these soils (see Tables II. and III.).

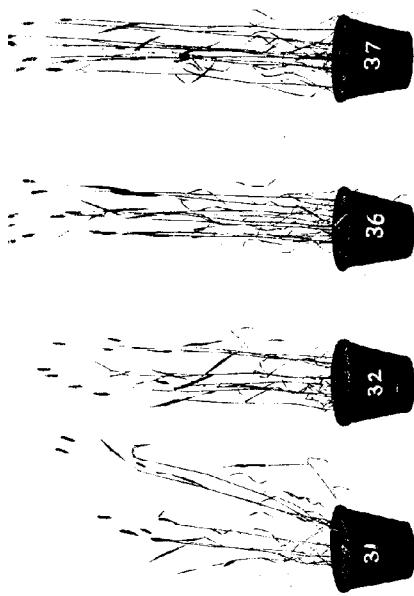
To What is the Accumulation of Fertility due?—In considering this subject it naturally occurs to one to inquire whether the unused residue of the slag applied to the grass may not have had a large effect on the oats, mustard, and wheat. In the "untreated" series of pots for each centre, one pot, the third in each case, received 1 gramme of slag in 1914 before sowing the oats. Although small in actual amount this is really a relatively large dose, and is probably equal to about 15 cwt. per acre.* The effect of this dressing of slag was apparent in the yields of all the soils, with the exception of Stoke Talmage, and the aggregate produce of the five crops of the five series of soils was increased by 12 per cent.

The third pot of the "treated" soil for each series also directly received a gramme of slag, which produced some effect in all cases, the average increase for the five crops of the five series being, however, only 5 per cent. The fact that the slag used in the pots produced less than half the increase when used on the "treated," as compared with the "untreated" soil, indicates that the slag used on the grass in previous years has left some residues that have reacted on the oats, etc., but these residues are very small.

Chemical analysis (see Table IV.) has been able to detect these residues in the case of three of the soils (Denton Hill, Cockle Park and Arncot), the increase of phosphoric acid in the "treated" soils of these centres being presumably due to slag residues.

When the yields of the two pots of "treated" soil are compared with the two pots of "untreated" soil (nothing being added to the pots in either case), the increase is found to be 27 per cent., and it may safely be assumed that, of this increase, only a small proportion is due to the effects of the residues of slag. Something else than slag residues has clearly been operative, and it seems safe to assume that this has been the humus,

* The figure is arrived at on the assumption that the effective soil on an acre weighs three million pounds. The pots contained, on the average, rather less than 4 lb. of dry soil. One gramme of slag added to 4 lb. of soil is equal to 750,000 grammes (= 15 cwt.) of slag for the soil of an acre.

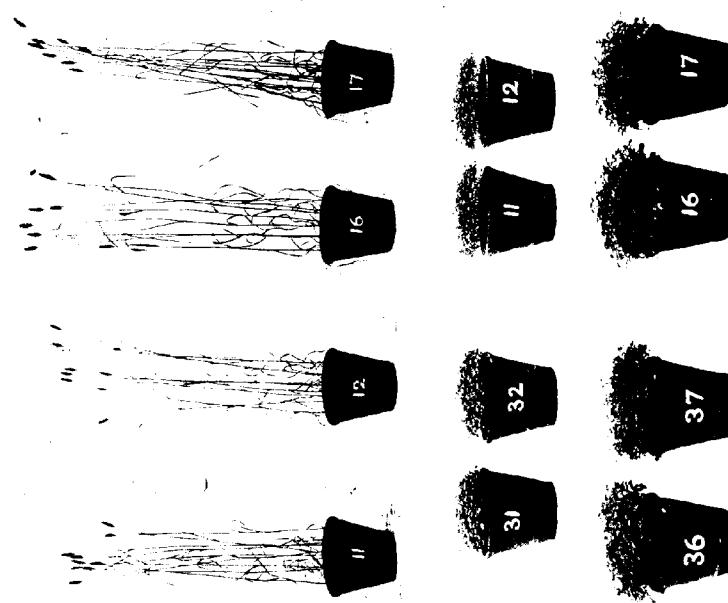


A.—Wheat of 1915, grown in Cockle Park soil. Pots 11 and 12 contained soil from the "untreated" part of Tre Field, while pots 16 and 17 got soil from a part of the field, which during 17 years had received an aggregate of 1½ tons of basic slag per acre. A crop of oats and 2 crops of mustard were taken from these pots in 1914.

B.—Wheat of 1915, grown in soil from Armitot, Oxon. Pots 31 and 32 contained soil from the "untreated" part of the field, while pots 36 and 37 got soil from a part of the field which received 5 cwt. of basic slag per acre in each of the years 1909, 1910, and 1911. A crop of oats and 2 crops of mustard were taken from these pots in 1914.

C. Second crop of mustard in 1915. Previously in the same year a crop of oats and a crop of mustard had been taken from these pots. Pots 11 and 12 contained soil from "untreated" part of Tre Field, Cockle Park, while pots 16 and 17 got soil from a part of the field, which during 17 years had received an aggregate of 1½ tons of basic slag per acre. Pots 31 and 32 are from "untreated," and pots 36 and 37 from "treated"

soil. Cf. p. 600, *et seq.* Oxon.



including the nitrogen stored up in the grass land before it was broken up.

That the nitrogen collected from the atmosphere and stored up in the humus is largely accountable for the increased production in the pots of "treated" soil, is shown by the results in pots to which $\frac{1}{2}$ grammie (7 cwt. per acre) of rape meal was added for the oats of 1914. In the "untreated" series of pots the rape meal, when used alone, increased the produce of the five crops of each series, except that of Stoke Talmage; the gross yield of the five crops of the five series, where no rape meal was used, being 418.6 grammes, as compared with 438.2 grammes where it was used, an increase, namely, of 5 per cent. For the "treated" series of pots the corresponding figures are 531.4 grammes without rape meal, and 521.9 grammes with it, the rape meal in this case having done no good. The fact that the nitrogen of the rape meal failed to act in the "treated" series of soils would appear to be due to the presence of abundant nitrogen stored up by the Leguminosæ, which were stimulated by the basic slag applied to the land when in grass.

The figures also provide a standard for measuring the amount of such accumulated fertility, for whereas the crop-increase on "treated" but directly unmanured soil, as compared with similar "untreated" soil, averaged 27 per cent, it was only 5 per cent. under the influence of the rape meal. Apparently, therefore, the nitrogen stored up in an acre, as the result of slagging the pastures, is greater in amount than that present in 7 cwt. of rape meal.

The increase in nitrogen in the soil is distinctly shown by the chemical analysis made by Mr. C. G. T. Morison, Lecturer in Agricultural Chemistry, of the soil samples taken in the spring of 1914, when the pot experiments were started. The results are set out in Table IV., and show that the total nitrogen has been largely increased at Cockle Park, and to a less extent at Denton Hill and Arncot. At Stoke Talmage and Lees Rest no accumulation of nitrogen was detected by chemical analyses. These results are in general agreement with those obtained by the growth in the pots of wheat, oats and mustard, that is to say, the three series (Denton Hill, Cockle Park and Arncot), showing the large crop increases, are also those showing the increases of nitrogen, while the two that show no increase in nitrogen (Stoke Talmage and Lees Rest) are also those showing practically : increase in crop produce.

Summary and Conclusions.—(1) When basic slag is used on grass land the increase of herbage, or of meat or milk, does not represent the whole of the benefits. Concurrently with such increase

TABLES II., III., AND IV.

Denton Hill.		Cockle Park.		Stoke Tamme.		Ariots.		Loss Rest.	
"3 Pots of "Untreated," "2 Pots of "Treated," "1 Pot of Soil.		"2 Pots of "Untreated," "2 Pots of "Treated," "1 Pot of Soil.		"2 Pots of "Untreated," "2 Pots of "Treated," "1 Pot of Soil.		"2 Pots of "Untreated," "2 Pots of "Treated," "1 Pot of Soil.		"2 Pots of "Untreated," "2 Pots of "Treated," "1 Pot of Soil.	
Oats, 1914.	"	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
2 Mustard Crops, 1914.	"	17.0	38.0	15.0	34.0	17.5	37.5	16.2	37.0
2 Mustard Crops, 1915.	"	6.876	72.8	7.75	42.3	7.50	43.0	8.72	44.7
Wheat, 1915.	"	5.670	62.0	5.95	45.5	5.50	46.0	6.870	48.0
Mustard "	"	19.8	27.8	33.2	45.8	33.6	27.9	34.7	33.2
Total ..	"	16.8	19.6	16.4	24.6	19.1	20.9	17.3	21.4
		as 100	as 100						
TABLE II.									
Oats, 1914.	"	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
2 Mustard Crops, 1914.	"	17.0	38.0	17.5	37.5	17.5	37.5	16.2	37.0
2 Mustard Crops, 1915.	"	6.876	72.8	5.95	45.5	6.70	45.0	8.72	44.7
Wheat, 1915.	"	5.670	62.0	5.50	45.0	5.30	44.5	6.870	48.0
Mustard "	"	19.8	27.8	33.2	45.8	33.6	27.9	34.7	33.2
Total ..	"	16.8	19.6	16.4	24.6	19.1	20.9	17.3	21.4
		as 100	as 100						
TABLE III.									
Oats, 1914.	"	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
2 Mustard Crops, 1914.	"	17.0	38.0	17.5	37.5	17.5	37.5	16.2	37.0
2 Mustard Crops, 1915.	"	6.876	72.8	5.95	45.5	6.70	45.0	8.72	44.7
Wheat, 1915.	"	5.670	62.0	5.50	45.0	5.30	44.5	6.870	48.0
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		as 100	as 100						
TABLE IV.									
Oats, 1914.	"	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
2 Mustard Crops, 1914.	"	17.0	38.0	17.5	37.5	17.5	37.5	16.2	37.0
2 Mustard Crops, 1915.	"	6.876	72.8	5.95	45.5	6.70	45.0	8.72	44.7
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Mustard "	"	19.8	27.8	33.2	45.8	33.6	27.9	34.7	33.2
Total ..	"	16.8	19.6	16.4	24.6	19.1	20.9	17.3	21.4
		as 100	as 100						

* Figures for the oat crop at this Station rejected, as previously explained.

"Untreated," "Treated," "Untreated," "Treated," "Untreated," "Treated," "Untreated," "Treated," "Untreated," "Treated,"									
Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.
Total Nitrogen	"	3.95	7.00	3.05	5.00	2.78	4.00	5.11	3.33
Ammoniacal Nitrogen	"	1.653	1.953	0.912	1.004	0.604	0.604	0.604	1.369
Total Phosphoric Acid	"	0.615	0.612	0.49	0.49	0.37	0.37	0.37	0.604
Organic Phosphoric Acid	"	0.612	0.612	0.305	0.305	0.25	0.25	0.25	0.774
Total Soluble Phosphoric Acid	"	1.228	2.266	1.117	2.101	0.729	1.041	0.933	1.002

there is improvement in the fertility of the soil, and probably such improvement is in direct proportion to the increase of herbage, meat or milk.

(2) The extent of the accumulation of fertility depends on the amount of slag used, on the period of time during which it acts, and on the way in which the land responds to it. In the Cockle Park series the oats, wheat, and mustard grown in 1914 and 1915 were improved 70 per cent. as the result of the liberation of this fertility, and the fifth crop (mustard, 1915) shows practically no sign of the beginning of the process of exhaustion. On other soils, which had not been so liberally, or so long treated, the storage of fertility was less in amount (Denton Hill and Arncot), though here, also, five crops had not exhausted it. In the case of soils from two centres (Stoke Talmage and Lees Rest) pot culture showed little, if any, storage of fertility. This negative result may be due partly to the unsuitability of these soils for pot culture, and partly to their unsuitability for the growth of mustard, the failure to disclose accumulated fertility resting with this plant rather than with the two cereals. The fact, however, that chemical analysis failed to reveal any increase of nitrogen in these two soils, seems to indicate that local conditions affect the accumulation of fertility. The average increase of fertility, as disclosed by the growth of five crops in the five soils employed, was 27 per cent.

(3) The fertility that is accumulated seems to be largely due to nitrogen stored up by leguminous plants, though increase in non-leguminous humus is probably not without influence. Residues of slag appear also to play some small part in the result.

(4) In the event of the extension of the tillage area the individual and the nation will both benefit from the enterprise of farmers who have, during past years, freely used basic slag on their grass land. While these experiments are confined to the effects of basic slag, there is no reason to doubt that similar results would have been obtained with other effective forms of phosphate.

(5) While the returns from the use of phosphates on grass land are chiefly to be looked for in the form of increase in the quantity and quality of the hay crop, or in the increased production of meat or milk, or in the improved well-being of farm stock generally, the residual fertility must not be overlooked. Even if it could do no more than accomplish a 10 per cent. increase in two tillage crops this would be sufficient in many cases to repay the original cost of the treatment.

THE GROWING OF SUGAR BEET.

IN view of the present state of the sugar supply it is of great importance that efforts should be made to establish the sugar beet industry in this country, and that the fullest possible use should be made of such facilities as already exist for the manufacture of sugar from beet. Sugar beet has been grown experimentally in many parts of Great Britain for several years, but it is only since 1912 that growers have been able to dispose of their crops for the manufacture of sugar. This development is due to the enterprise of the Anglo-Netherland Sugar Corporation, Limited, who erected a factory at Cantley, in Norfolk. In the 4 years during which the factory has been in operation the average quantity of sugar-beets "worked" has been about 20,000 tons per annum, or, approximately, one-fourth of the quantity necessary to keep the factory running at full pressure. The factory "campaign" is a short one at best, as the beet must be "worked" as soon as possible after the crop is lifted, in order to prevent waste. It will thus be apparent that the industry has not yet reached the stage of development at which satisfactory results can be expected, and the difficulties which the Corporation have had to face are largely attributable to failure to obtain adequate supplies of raw material. If the industry is to secure a permanent footing, the co-operation of farmers ready to provide sufficient supplies of beet is essential.

In the year which has just closed the factory dealt with the produce of about 2,150 acres. The crops, on the whole, were satisfactory, yielding, on the average, just over 9 tons of washed roots per acre. The sugar content of the beet also was very good, namely, 17.36 per cent, a figure comparable with that obtained under the most favourable conditions on the Continent. Growers were paid for their crops in accordance with a sliding scale of prices based on the average selling price of sugar secured by the Corporation, viz.:-

<i>Average Sale Price of Sugar per cwt.</i>	<i>Price for Sugar Beet per ton.</i>	<i>Average Sale Price of Sugar per cwt.</i>	<i>Price for Sugar Beet per ton.</i>
<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
19 0 (or under)	25 0	24 0	30 0
19 6 ..	25 6	24 6	30 6
20 0 ..	26 0	25 0	31 0
20 6 ..	26 6	25 6	31 6
21 0 ..	27 0	26 0	32 0
21 6 ..	27 6	26 6	32 6
22 0 ..	28 0	27 0	33 0
22 6 ..	28 6	27 6	33 6
23 0 ..	29 0	28 0	34 0
23 6 ..	29 6		

On this basis farmers received 30s. 8d. per ton f.o.r. for washed roots, representing an average return per acre of about £14.

Cost of Cultivation.—Figures relating to the cost of growing the crop in Norfolk and Suffolk in 1914 were published in this *Journal* for February, 1915, in an article contributed by Messrs. Orwin and Orr, of the Research Institute in Agricultural Economics, Oxford. Labour difficulties were somewhat more acute in 1915, but the actual cost of cultivation does not appear to have been materially greater than in the previous year. One grower unable to obtain man labour for lifting resorted to women. He reports that "during two of the wettest months I have ever known—November and December—18 women at piece-work lifted and topped 50 acres of sugar beet at about the same cost as it would have been had men undertaken the work."

Another grower produced, at his first attempt, 14 tons of washed roots per acre, at an estimated cost of from £11 to £12 an acre. He reports, "I am so satisfied with the result that I am going to grow 50 acres this season and, had it not been for the war, would have doubled this acreage." He states, further, that he found the lifting easier than he anticipated, "women, by using a fork to loosen the soil, lifted the beets quite easily and at moderate cost."

The following figures supplied by Mr. B. S. Sillem show the average cost of cultivation per acre on the Cantley Manor Estate, in 1915, the soil being a uniform free-working loam:—

	£ s. d.
Two ploughings	16 0
Subsoiling	8 0
Farmyard manure, 10 tons at 3s. 6d. per ton	1 15 0
Harrowing and rolling before sowing	3 0
Rolling after sowing	1 0
Seed—15 lb. per acre	6 3
Drilling	1 9
Artificial manures	2 0 0
Chopping out and singling	1 5 0
Horse-hoeing, 3 times	6 0
Lifting and topping	1 5 0
Carfing	1 4 0
Rent, rates and taxes	1 5 0
Cost per acre	£10 16 0

Altogether Mr. Sillem grew 295 acres of beet in 14 different fields, the total yield obtained being 3,761½ tons of washed roots, which works out at the rate of 12 $\frac{3}{4}$ tons per acre, worth £19 11s., exclusive of the value of the tops. The highest yield of washed beet—15 tons—was grown on a field of 29½ acres. The lowest yield of any was 10 tons of washed beet per acre. The average amount of dirt deducted was 14 per cent.

Some inconvenience was caused at singling time, owing to a strike of workmen, and about 68 acres were "bunched" by machinery.

Incidentally it may be mentioned that the heaviest crop of beet followed a crop of wheat which yielded $6\frac{1}{2}$ qr. per acre. The wheat was manured with 2 cwt. of sulphate of ammonia per acre in autumn and 1 cwt. per acre of nitrate of soda in the following spring.

It is not claimed that the figures assigned to the various tillage operations are more than approximately correct, or that they are necessarily typical of conditions generally in the Eastern Counties, but it may be mentioned that the ordinary cost of cultivation on light land in the Eastern Counties was usually estimated before the war at from £8 10s. to £10 15s. per acre, and on loamy soils in other parts of England at from £10 to £12 per acre.

Indirect Advantages.—Against the cost of production must be set, in addition to the price obtained for the crop, certain indirect advantages accruing from the cultivation of sugar beet. There is almost general agreement that the extra treatment in the form of subsoiling, cleaning and manuring benefits the subsequent crops, though to what extent has not, so far, been accurately determined. Another item that must be considered is the value of the leaves and crowns left on the land after the crop has been removed. One grower of 50 acres reports that the residue referred to has kept 300 breeding ewes for 3 months, thus replacing about 25 acres of turnips, which at £5 per acre has meant a saving of £125. Cases are common where feeding on the tops has been let at 20s. an acre, and this figure is much below that usually assigned to the residue by continental growers.*

The tops are rich in potash and, when ploughed under, their manurial value is considerable.

By-products.—Of the factory by-products the chief is the dried slices or pulp, the residue after the extraction of the greater part of the sugar from the beet. This usually represents about 10 per cent. of the weight of beet manufactured: it is easily transported and it constitutes a useful feeding-stuff. During the past season dried pulp (protos) has been selling at £8 and upwards per ton. Dried pulp prepared by the process in use at Cantley and containing 8·6 per cent. of moisture, if soaked in 9 parts by weight of water would contain as much dry matter as man-

* The feeding and manurial values of sugar beet crowns and leaves, *Journal*, November, 1915.

golds of good quality, and from the standpoint of feeding units would be rather more valuable in the proportion of 17·5 per cent. in the soaked pulp to 14 per cent. in Golden Tankard Mangolds.

At £8 per ton for dried pulp the soaked pulp costs 16s. per ton, and if the actual values of the two foods are represented by the ratio 17·5:14, then with soaked pulp at 16s., mangolds would be worth 12s. 9d. per ton. It would seem, therefore, that the stockfeeder who values his mangolds at 12s. 9d. per ton, would be able to provide a substitute if in place of putting all his root land under mangolds he devoted a share to sugar beet and bought in dried pulp at £8 per ton.

Another by-product of special value at the present time is molasses, the yield of which is usually at the rate of about 2 per cent. of the weight of beets worked.

General.—Reports received by the Board furnish evidence that growers, as a whole, are well pleased with the results of last year's operations. Owing to the high price of store cattle in the autumn of 1915, coupled with the increased cost of feeding-stuffs, it is to be feared that fattening cattle have left little, if any, profit to the feeder. Apart from national considerations, it is becoming more and more clear that the introduction of sugar beet would be a distinct gain to British agriculture, inasmuch as it would provide an alternative to cattle- and sheep-feeding in years when stock are unprofitable. It is not suggested, of course, that anyone should entirely substitute beet for mangolds and swedes, but if a farmer had a certain area under each crop he would be less dependent on fluctuations in the value of live stock. The greater the number of saleable crops produced the safer the system of farming. At the present time labour difficulties prevent farmers from growing much sugar beet, and to attempt to grow more than they can deal with satisfactorily is, of course, inadvisable.

With its present equipment the Cantley factory could easily handle about 60,000 tons of washed beet in a season, that is to say, the produce of from 6,000 to 7,000 acres, assuming a yield of 9 tons per acre (the average crop produced last year). This acreage would represent only about 1/40 of the total area annually under roots and bare fallow in the counties of Norfolk and Suffolk alone. In the past, however, beet has also been grown for the Cantley factory in Lincolnshire, Cambridgeshire, Huntingdonshire, Hertfordshire and Essex. If farmers within reasonable distance of Cantley would grow even a very small acreage of sugar beet, the needs of the

factory would be adequately met and the foundations of a successful industry would be securely laid. With the conclusion of the war and an increase in the supply of sugar, a fall in the price of beet may be anticipated; but in the meantime farmers would gain an experience of the crop which should enable them to reduce the cost of growing and to secure a somewhat heavier and steadier yield.

The prices offered for next crop are based on the same sliding scale as that in vogue last year, as given above.

Advice on the cultivation of the crop, the purchase of seed, lifting and cleaning of the roots, etc., will be supplied to growers on application to the Manager, Beet Sugar Factory, Cantley, Norfolk.

It may be pointed out that sugar beet has a considerable value for feeding purposes, apart from any question of the production of sugar. In cases, therefore, where trial crops are grown to ascertain the capabilities of the soil and locality for growing sugar beet, the crops can be turned to useful account, even where it is not possible to dispose of them for sugar manufacture. Analyses show that, on the average, sugar beet contains from 20 to 25 per cent. of dry matter as compared with 9 to 13 per cent. in mangolds. Although the relative feeding values of sugar beets and mangolds have not been definitely determined in this country, the results of Danish and American experiments show that, for feeding purposes, 4 lb. of beet are approximately equal to 8 lb. of mangolds or 1 lb. of cereal meals in mixed rations. Farmers who are unable to grow beet in sufficient quantity to make a contract with the Anglo-Netherland Sugar Corporation, but would like to grow a few rows among their mangolds as an experiment, may obtain $\frac{3}{4}$ lb. of seed, post free, from the offices of the Corporation, Cantley, Norfolk, for a postal order for 1s. The seed should be dibbled in, 2-3 seeds together, in holes 8 in. apart when sowing mangolds.

Further information on the subject of sugar beet growing as practised both in this country and on the Continent is contained in an article entitled "Notes on the Sugar Beet Crop," which appeared in this *Journal* for February, 1915.

FARM VALUATIONS FOR BOOK-KEEPING PURPOSES.

JAMES WYLLIE, B.Sc., N.D.A.,

Lecturer on Book-Keeping, West of Scotland Agricultural College.

IT must be admitted that the great majority of farmers are slow to realise the advantages to be derived from a proper system of book-keeping on the farm, and they are, perhaps, too prone to over-estimate the difficulties connected with even the simplest system which can be laid before them. The recent change which has been made in the basis for assessing farm income tax should, however, lead many farmers to consider seriously whether it would not be to their advantage to adopt some method of book-keeping which would enable them to claim assessment on their actual profits instead of on their full yearly rental. The object of this article is to indicate how the farmer should proceed to lay a sound and necessary foundation upon which he may construct whichever system of accounts he considers most suitable for his particular circumstances.

The first step which a farmer has to take when he decides to keep systematic accounts is to make a complete inventory and valuation of all the various classes of stock, both live and dead, upon the farm. He must also make out an accurate statement of all debts payable and debts receivable, and ascertain how much cash he has in hand and in the bank. In other words, he must draw up a Balance Sheet showing his total assets and total liabilities and thence find how much *Capital* he has invested in the farm.

This *Balance Sheet* will have to be revised periodically, usually annually, upon the farm. From it the farmer can judge whether his capital in the farm is increasing or decreasing, but it does not show what profit or loss has accrued from a year's working of the farm. It cannot be too strongly emphasised that a reliable balance sheet is the bed rock of all reliable book-keeping, and the foundation of a reliable balance sheet lies in the making of a fair, just and reliable valuation of stock. This applies particularly to farm accounts, since market prices for farm produce fluctuate very considerably from year to year, and even from month to month. Two aspects of the annual farm valuation or stock-taking require careful consideration, viz.: (A) The Date at which the Valuation should be made, and (B) the Principles upon which it should be made.

(A) **The Date of Valuation.**—Generally, the most convenient date will be at one of the usual terms of entry to farms, viz.: Lady Day (25th March) or Michaelmas (29th September) in England, and Whitsunday (28th May) or Martinmas (28th November) in Scotland. It will be an advantage if the farmer can square up his accounts in the usual way in the event of his leaving one farm for another, but no hard and fast rules can be laid down, and much will depend upon the particular system of farming followed.

It will be readily admitted that the best and most desirable date will be that at which there is the minimum of valuation to effect, and it should also be borne in mind that it is much easier to value some kinds of stock than others. No matter what methods are followed in determining values, the work will be easier and the results more reliable if the valuation is made when the amount of marketable stock on the farm is at a minimum. At what period of the year, then, is this date most likely to occur? How far does each of the common dates of entry satisfy this condition?

Taking a broad, general view there is one fundamental objection to Michaelmas or Martinmas as a date for the farm stock-taking, viz., that it falls practically in the middle of the farmer's year. Consider the case of oats sown in the spring of 1915. It is perfectly clear that, in the great majority of cases, it would require *two* years' accounts to show the actual profit (or loss) on this crop, for a great part would still be in stock at either of these dates, and only a paper profit (or loss) could be shown in the books for 1914-15. And so for other crops. Now it is highly desirable that the book-keeping year should, as far as possible, correspond with the farming year, which commences in the spring rather than in the autumn. Lady Day or Whitsunday is certainly much nearer the beginning of the farming year, and on that account should be generally preferred to Michaelmas or Martinmas. It is remarkable that many valuers prefer to take stock at Michaelmas or Martinmas on the ground that there is more stock to value then than in the spring, ignoring the fact that a valuation, for book-keeping purposes, is at the best to be looked upon as a necessary evil, which should be avoided as far as possible.

The argument in favour of a spring rather than an autumn valuation is strengthened by considering the case of crops. At Michaelmas or Martinmas the crops will be very largely harvested, and only a small part of the tillages for next season's crops will have been done. But only a small proportion of the

crop will have been disposed of, either by sale or by consumption on the holding, and the extent of the necessary valuation will be very great. In other words, either of these dates falls between the harvesting and the realisation of the crop. With a spring valuation, on the other hand, the greater part of the previous season's crop will have been realised, and only the costs of the tillages, etc., for the current season's crop will fall to be determined. As will be shown later, it is much easier to value tillages than crops in stacks or in pits, the amount of valuing to do will be considerably less, and the book-keeping year will correspond more closely with the cropping year.

As regards live stock and other classes of dead stock, it would appear to be largely immaterial at what date these are valued, although here also the balance is in favour of a spring valuation, since the stock-breeder's year, as well as in many cases the stock-feeder's, generally commences in the spring rather than in the autumn.

Given a free choice, however, it cannot be said that either Lady Day or Whitsunday is the best date for valuation on the average farm. The former is perhaps rather early, the latter rather late. In any case, in view of what has been said above, it would be desirable to delay stock-taking until at least very little of the previous year's crop remains to be disposed of.

It may, therefore, be generally recommended that on the average cropping, stock-feeding, dairy or mixed farm the valuation for book-keeping purposes should be made at the most convenient date between Lady Day and Whitsunday. In regard to the hill *sheep farm*, however, the best date would fall between about the end of August and the end of September, that is, after the season's crop of lambs, etc., has been sold off, and the breeding stock made up for the next season. In this case, the farming year commences in the autumn, and the valuation should be made accordingly. The deciding factor is the same as for the average lowland farm, viz., that at this time there is a minimum of stock to value, the valuation is easier and the result more reliable.

(B) **The Principles of Valuation.**— Two leading principles in the valuation of stock of all kinds may first of all be enunciated, viz.: (1) The values fixed must on no account be too high, that is, it should be possible at any time to realise the values put upon the stock. The farm valuer too often ignores or forgets this principle. (2) Uncompleted articles of all kinds, e.g., growing crops, young stock, etc., should be valued at cost of production up to date. Further, where it is not possible to fix the values

automatically, that is from cost-accounts, the valuation should be done by an independent party and preferably by the same party from year to year. Bearing these general principles in mind, the various classes of stock may be discussed in some detail.

(a) CROPS.—This section should give little trouble to the qualified valuer. Generally, the basis of valuation should be *cost of production* up to date. With a spring valuation, the value would include the cost of the various tillages, seed, manure, etc., whereas with an autumn one it would embrace summer cultivations and perhaps harvesting as well, along with a proportion of the yearly rent, rates and taxes. Hence, the spring valuation entails much less labour, so far as growing crops are concerned. Where cost accounts are kept, the values would be automatically determined in the respective crop accounts, but in other cases (the great majority), and in any case for the first year or so, the cost of production would have to be estimated. A list of the cost of the various operations—ploughing, harrowing, drilling, etc.—could be drawn up, and these would not vary much on the same farm from one year to another. In fact, it would be fairly accurate to keep the estimated cost per acre for each crop at approximately the same figure from year to year, although there would of course be differences in the number of acres of the various crops, which would affect the total value.

The chief difficulty as regards crops lies in valuing those in stacks, pits, etc., and it should be noted that this difficulty scarcely arises where the valuation is made at a suitable date in the spring. Here it will be found that the valuer very generally ignores the cost basis and fixes the values according to current market prices or, it may be, on what is known as feeding or consuming value. So far as the consuming value basis is concerned, little objection can be taken from a purely book keeping point of view, since the values are not likely to vary much from year to year. Not so with the market value basis, however. A farmer may have about 100 tons of potatoes in pits at, say, Martinmas, and the current market price may be £3 per ton; but neither the farmer nor the valuer can foretell the price at which the potatoes will actually be sold, or indeed whether they will be sold at all. The result must be that the profit (or loss) shown after such a valuation has been made is a purely fictitious or paper one. It cannot be gainsaid that by far the soundest method of dealing with the potato or other crop under such circumstances is to carry it forward at cost. *No real profit can possibly accrue from produce which is still in stock.*

There is a further difficulty in dealing with harvested crops, viz., the difficulty of estimating the *quantity*. In the example taken above, who can guarantee that there are 100 tons of potatoes, neither more nor less? It is a case of raising difficulties and opportunities for errors where none need exist. How much easier it would be to take so many acres and value them at cost per acre.

(b) **LIVE STOCK.**—With this class of stock also the valuer would be well advised to base the valuations generally upon cost price, but there are certain important exceptions which are discussed below. It would appear that old methods—often utterly unsound—are continued in practice through a misunderstanding of the real object of making a valuation for book-keeping purposes. Broadly speaking, the fundamental object is, *not* to show what the farmer is worth, nor yet to show what capital is invested in the farm, but to assist in the determination of the actual profit or loss from the year's actual financial operations. It is this object which the valuer must keep primarily in view: it is only under special circumstances that the other objects mentioned become of first importance.

Live stock may conveniently be divided into two classes, according to whether they are kept for the specific object of *direct* profit-making. Horses, for example, are mainly kept for the labour they perform, cows for milk (and calves), ewes for lambs (and wool) and sows for pigs. In brief, horses and breeding stock generally may be looked upon as machinery for turning out other products from which the profits are derived. On the other hand, feeding stock (cattle, sheep and pigs) are expected to yield a direct profit; they produce nothing else (except wool) from which a profit may be obtained. Hence, the valuer should keep this distinction in mind in deciding upon the method of valuation which he will apply to different classes of live stock.

Cattle.—Take first the case of *milk cows*. The question at once arises: are these to be valued at cost price, at market value or at some figure intermediate between cost and market price? Recent experience on the dairy farm provides an excellent illustration of the results which would obtain from the different methods.

Consider, for example, a milk-selling farm on which there is a regular herd of 40 cows (*i.e.*, each cow will remain in the herd for from 3 to 6 years, according to quality, etc.). At Lady Day, 1914, the herd was valued, on a market basis, at £18 per head, while at Lady Day, 1915, the corresponding figure rose to £22

per head. In effect, it is clear that this would have resulted in a "profit" of £160, apart altogether from considerations of milk-yield, milk prices, cost of feeding, etc. Now, in point of fact, the year 1914-15 was in many cases a lean year for such farmers, on account of existing milk contracts at pre-war prices, high prices of feeding-stuffs, dear labour, and so forth, and, but for the increased valuation, the year would very probably have shown a profit below, instead of above, the average. The above £160 is a purely fictitious profit; it does not represent real profit from actual transactions, since most of the cows will remain on the farm for several years longer; and the balance in the farmer's bank account would not bear out the increased profit shown in his books. No qualified accountant could possibly approve such a method; it is against one of the fundamental principles of ordinary business valuations.

As already indicated, such a method is largely followed because the valuer fails to realise that the primary object of keeping an account for cows is to discover the profit (or loss) from milk-production and *not* to show what profit *might* be made *if* all the cows were to be sold off. We need have no hesitation, therefore, in discarding this method of valuation with reference to milk cows.

Coming now to the cost basis, an initial difficulty has at once to be dealt with. What is the net cost of production of, say, a home-bred 5-year-old cow, which has been 2 years in the herd? On the one hand, we have the cost of feeding, labour, etc., but on the other we must put the value of the milk and calves which she has produced. Further consideration would at once show that the cost basis is *not* applicable to such stock, for the reason that in a high-class herd the values would come out lower than in a poor herd. We have, therefore, to fall back upon a third method, which takes account both of cost and of market value. The principle can best be explained by taking a specific case.

An average or "standard" Ayrshire cow may cost, say, £14 to bring into the herd, that is, up to the date of her first calf at about three years old. Thereafter, she may be expected to increase both in market value and in intrinsic value as a milk-producer by from £2 to £3 per annum for the next two or three years and then decrease in value by from £3 to £4 per annum for the following three or four years, after which she will be disposed of. Taking the successive valuations to be £14, £16, £18, £15, £12 and £9, this would give an average of £14, and since there would be approximately the same number of cows of the various ages in the herd "the standard value," as it may be called,

may be fixed at £14 per head. This principle can, of course, be applied to any herd and the standard value thus obtained. It should be observed, however, that this standard value should be so low that the average market value of the cows in the herd is not likely to fall below it, unless under highly abnormal conditions.

We thus fix upon the "standard value basis" for the valuation of dairy cows in the regular herd. In practice, each cow may be valued separately as above indicated, but in large herds accurate enough results will be obtained by valuing the herd at so much per head. It is clear that the total valuation will depend upon (1) the numbers of the various ages in the herd (in some years more old cows may be sold off and more heifers brought in than in others), and (2) whether the intrinsic and therefore the average market value of the standard cow in the herd is being raised (where milk records are kept the standard value could be gradually raised, not only because of higher average milk yield, but also because of higher average market value).

To revert now to the case given above. The standard value at Lady Day, 1914, may have been fixed at £16 per head, and the same figure may have been taken at Lady Day, 1915. The accounts would then show the actual profit (or loss) from the year's monetary transactions (in milk, calves, etc.); the farmer's books would corroborate the evidence of his bank-book and agree with his own general impressions as to the year's financial results. In effect, the dairy herd should be looked upon as a factory for turning out milk (with calves as a by-product), the profit from which depends upon the price of milk, cost of feeding, labour, rent, etc., and only to a very limited extent upon the market price of the cows themselves.

The valuation of *purchased cows* still remains to be considered, and may, at first sight, present considerable difficulty. Taking the extreme case of the so-called "flying stock" where the cows are bought in, milked for about a year and then sold off just as they stand, three points may be noted: (1) There will be considerable depreciation in market value between buying and selling—from £5 to £10 per head; (2) the profit from the herd as a whole depends to a greater extent upon the market price of the cows than in the case of a regular herd; but (3) the main profit still comes from the milk produced—the cows in this case being merely machinery which wears away quickly and has to be replaced very frequently. Even in such a herd, however, the average value of the cows at, say, Lady Day, will not vary very much from year to year, since the cows will be purchased at

different dates throughout the year and the valuation may again be quite accurately based upon the value of the average or standard cow in the herd. This standard value may be calculated by making a detailed valuation at market prices in normal times and then finding the average value per head. The total valuation will vary according to the number of cows in the herd and the quality of the herd as a whole, but the object must be to make the valuation correspond as nearly as possible to *normal* market value without by any chance exceeding it.

The case of cows has been treated in such detail in order to present and analyse general principles which will apply more or less completely to all classes of breeding stock.

In passing, a reference may be made to the valuation of cheese on the dairy farm. This should occasion no difficulty as, if the valuation is made at the date suggested, little cheese will be in stock, and, in view of the extreme difficulty in accurately determining the cost of production, it may be valued at a little under current market price.

Other Classes of Cattle.—Young dairy stock, home-bred and purchased feeding stock, etc., should give little trouble and should almost invariably be valued on a basis of cost up to date. Although it is undoubtedly true that in the case of store cattle purchased for fattening purposes the profit will be largely influenced by the relative market prices per cwt. at buying and at selling, it is nevertheless equally true that neither with such cattle nor in the case of home-bred fat cattle can any real profit emerge until the cattle are marketed. It is only such profit that will pay the rent. It is time that valuers recognised that valuations should be based upon what the farmer is *doing* and not upon what he *might do*. He *might* sell his calves as stores, but what he actually *does* is to sell them as fat bullocks. It is the latter *fact* which the valuer should bear in mind and act upon and not the former *supposition*.

Horses.—Since the number of horses on the average farm is relatively small and the individual values relatively high, each horse should be valued separately. In the case of young horses, not yet broken to work, the valuation should be on a cost basis, whether they are home-bred or purchased. The same principles apply as in the case of young cattle.

Work horses, again, are in the nature of machinery, with the important difference that after being installed they appreciate in value for a certain number of years before depreciation sets in. Probably the following method would suit the majority of cases. Allow a certain figure, say £35, as the value of an average three-

year-old fully broken to work. This may be called the "standard value" of three-year-olds, and should be such a value that the market value is not likely to fall lower, although it may be above the actual cost of production. In succeeding years it may be reckoned that the average horse will appreciate, both intrinsically and in market value, by, say, £5 per annum until a maximum of £45 or £50 is reached, after which depreciation may be allowed at a gradually increasing rate per annum until the horse stands in the books at, say, £2 at 16 or 18 years old. Any marked increase or decrease in quality compared with the standard must, of course, be allowed for, as in the case of valuable pedigree horses. This is doubtless a somewhat arbitrary method of fixing values, but no more so than the usual business method of allowing depreciation on machinery and plant of all kinds. At any rate it is preferable to a valuation on a market basis. Good quality farm horses have increased about 30 or 40 per cent. in value since the early days of 1914, but this does not mean more money in the farmer's pocket: it is just as likely to mean less. With a market basis, a rise in market value might result in a considerable paper profit being shown on the work horses, which is almost as unreasonable as showing a profit on the farm implements, for these also have increased in market value since the war commenced. From a book-keeping point of view work horses are machinery, and should be treated strictly as such.

In valuing purchased work horses, consideration must be given to the purchase price and to any depreciation or appreciation in value since the date of purchase, but care should be taken that the valuation price is never higher than the market value, although it may well be lower. Horses bought at the present high prices are likely to undergo more rapid depreciation in value than in normal times, but the standard value of such horses must also be reckoned higher.

Other Live Stock.—As regards *sheep*, *pigs* and *poultry*, these should be dealt with upon exactly the same principles as have been outlined for cattle and need not be discussed further.

Taking the above principles of valuation for crops and live stock as established, the following objection falls to be noticed. It may be urged that the cost valuation will not show what capital is actually invested in the farm at the date in question, and it is perfectly true that in the event of bankruptcy or of death, or of a partnership formation, the valuation would require to be upon a strict market basis. But under normal circumstances the fundamental object of making a valuation is, as already mentioned, to assist in fixing the actual profit on the year's actual

financial operations, and this can only be attained by taking cost prices or standard values. No farmer need be alarmed if he is assured that he has rather under-estimated the amount of capital in his farm, for this condition obtains in all sound business concerns, but where the capital is over-estimated it often means that the business is perilously near taking the high road which leads to the bankruptcy court.

The case of the initial stocking of a farm must also be noticed in passing. Here, everything will usually be stocked at market value without any regard for cost of production or standard value. On such a farm, the valuations will gradually fall in amount for several years after entry, but this is to be expected. The stock brought on will not represent a normal stocking, *e.g.*, the cows will be mostly of the younger and more valuable classes, the horses will be largely in their prime, and so on. It is only natural, therefore, that such stock will suffer depreciation until normal conditions are reached, after which the valuations will remain fairly constant in amount, but subject to the factors discussed above.

(c) MACHINERY AND IMPLEMENTS.—This class of stock should present no difficulty to the skilled valuer, although it has increasing importance in these days of expensive, complicated, labour-saving machines, such as self-binders and oil-engines. At the first valuation, a detailed list must be made and approximate market value attached to each unit. Thereafter a certain rate of depreciation may be allowed upon the sum total. The rate of depreciation will depend chiefly upon the nature of the machine, the care taken in handling and storing it, and its age. Thus, depreciation is more rapid with very complicated machines, such as self-binders, when compared with simple machines, such as harrows; it will be greater with machines which are liable to go quickly out of date or which are only in the experimental stage, such as milking machines, than with those of a standardised character, such as steam-engines; it will be greater in the first year after purchase than in succeeding years, that is, many machines may be worth as much in the market after working 2 or 3 years as after working 2 or 3 months; and it will be least where the machines are skilfully handled while working and carefully cleaned and stored when idle. Bearing these points in mind, the actual valuation can be fairly made.

The simplest method in succeeding valuations is to write off a certain percentage for depreciation from the book value of the implements at the end of the year and, considering that the machinery will be very varied in character and will include units

of many different ages, with some purchased just the year previous to the valuation, this method will probably give fairly reliable results on the average farm. The rate fixed may run from 8 to 12 per cent, according to the factors discussed above. Under this method, a detailed valuation should be insisted upon at least every five years in order to ensure that the valuations are not too high, although it must be admitted that it is by no means easy to fix the market value of, say, a 10-year-old oil-engine or self-binder.

Some authorities advise making a detailed valuation of machinery every year and the extra trouble thus involved would not be very great. In any case, it would be advisable to value separately a few of the more expensive machines, such as oil-engines, agricultural motors, and milking machines. Even where a detailed valuation is not to be made annually, it might be a good policy to make a complete list of all such stock in order to keep track of the smaller utensils.

Certain other points fall to be noticed, viz.: (1) The depreciation may be written off the original value or off the diminishing value of the implements. In farm valuations the latter method is generally taken. If the same percentage be taken throughout it is clear that this would result in a gradually diminishing amount being written off each year, but this is probably quite sound, since, although the total depreciation is less with old implements than with new, the cost of repairs and upkeep is greater. (2) A limit of depreciation may be fixed for individual machines below which the value will not fall. Thus a set of harrows may cost £4 10s. In the first year depreciation may be 20 per cent, *i.e.*, 18s., and in following years the diminishing value may be depreciated by 8 or 10 per cent, until the harrows stand in the books at, say, 8s. or 10s. This principle is very sound, but can only be applied where the machines are valued separately. (3) Where a system of cost-accounts is being kept the implements should be valued in groups according to the department with which they are chiefly concerned, *e.g.*, ploughs and harrows would come under "crops"; a milking machine and dairy utensils under "cows"; and so on. By this means the cost of machinery may be allocated amongst the various revenue departments with some degree of accuracy. (4) All purchases would be debited to the Implements Account during the year, and if cost-accounts are kept the cost of repairs would also be debited, otherwise the latter should be charged to General Expenses. (5) Since the market value of this class of stock is very problematical, care should be taken to keep the valuation low enough.

(d) OTHER ITEMS IN THE VALUATION.—This section will include purchased seeds, manures and feeding-stuffs on hand, and these will, of course, be valued at cost, plus the expense of bringing them to the farm. It will also include tenant's fixtures (sheep-dipper, temporary buildings and fences, etc.) which had been taken over from the previous tenant and which will be valued at cost, less depreciation at, say, 10 per cent. per annum. Any new tenant's fixtures would be included here and would be valued on the same principles as for new machinery. The whole of the tenant's fixtures might be included under class (c), but it is preferable to keep them separate, as the accounts could then be introduced as evidence of their value to a succeeding tenant.

There still remain two items, viz., farmyard manure and unexhausted improvements, both of which present some difficulty and involve considerable difference of opinion as to how they should be dealt with in a valuation.

As to *farmyard manure*, there are some who hold that it should not appear in the books at all, but be treated as part of the soil which undergoes a certain cycle of changes from soil back again to soil. However sound this position may be under certain conditions, it is quite untenable where concentrated foods are being purchased and used in large quantities. One may even go so far as to maintain that on many arable-dairying and stock-feeding farms the yearly profit depends very much upon the skill shown in the production and utilisation of this commodity. Surely, then, it is necessary that particular account should be taken of it in the farm accounts. So far as the valuation is concerned, it appears to be hopeless to attempt to fix the cost of production per ton, although it is on this basis that farmyard manure should preferably be valued; nor is it possible, except in a minority of cases, to put a market value upon it. We have thus to fall back upon some arbitrary "standard value" for a certain quality, and, unless good reason can be shown to the contrary, the figures which are used in valuations between outgoing and ingoing tenants may be accepted as suitable for the purpose in view. These will run from about 4s. to 6s. per cubic yard of 14 to 16 cwt., according to the nature and quality of the manure. The estimation of the quantity on hand is a comparatively simple matter. It should be noticed, however, that where the valuation is made towards the end of May little farmyard manure may be in stock, as it may have been applied to the year's root crops. The only difference here is that the manure would be included in the cost of crops to date, instead of separately.

The remaining item is often ignored by valuers and book-keepers, but on a well-managed farm it may be one of the most important assets the farmer has—more important, in fact, than its market value under existing land laws would lead one to expect. It includes the *unexhausted value of such improvements as* drainage, laying down permanent and, it may be, temporary pasture, application of farmyard manure and of certain artificials, and consumption of feeding-stuffs. Under the Agricultural Holdings Act, the unexhausted parts of such improvements have now a more or less definite market value, which must be based very strictly upon their value to an ingoing tenant, and the valuer must keep this firmly in mind in assessing the amount, or a value may be given to this asset which cannot be realised at the end of the tenancy—the only time it can be realised except indirectly by gradual exhaustion.

In this case one has to follow the custom of the district in regard to outgoing valuations, and after the necessary preliminary assumptions have been settled the method is simple and should give little trouble to the valuer and book-keeper. The determination of these assumptions, however, is a most difficult matter, and the whole question is an extremely wide one, beyond the limits of the present discussion. The principle, however, may be explained with the aid of the following simple example. Suppose a farmer applied 10 tons of basic slag, costing £20, on the land, in October, 1910, how much would this be worth at Lady Day, 1911? Very little benefit would have accrued to the farmer before the latter date, and it may be *assumed* that practically the whole value yet remains in the land. To be on the safe side, this dressing may, however, be valued at £18 at Lady Day, being the sum which could probably be recovered from the landlord in the event of the farmer quitting the farm at Lady Day. During the year 1911-12, it may be assumed that one-half the value will be exhausted, so that at Lady Day, 1912, the valuation would be £9. One-half of the remainder would perhaps be exhausted during 1912-13, so that the Lady Day, 1913, valuation would include £4 10s. for this item, and so on, according to the "scale of exhaustion" commonly in use in the district. Other forms of improvement will present greater difficulties, but the valuer who is not qualified to tackle the whole question in the light both of common sense and existing laws and customs cannot be reckoned as fully qualified for the work he takes in hand to do.

In conclusion, two points may be noticed. In the first place, it may be said that other items may also appear in the valuation,

e.g., "acclimatisation value" on hill sheep farms, especially in Scotland; the "tenant-right" on Ulster farms; the "goodwill" on milk-retailing farms, and so on, but enough has been said about the principles of valuation to indicate how it can and should be made in order to ensure the result aimed at.

Secondly, it will be noticed that no mention has been made of the farmer's household effects or of his personal belongings, both of which would have to be considered if the object were to find the capital possessed by the farmer as an individual, as in the event of bankruptcy or of death. The farm as a business is not concerned with the way in which the farm dwelling-house is furnished nor with whether the farmer wears a gold watch or a silver one. It is only concerned with capital which is directly invested in it.

It will be noticed also that it has been assumed that the farmer is a tenant. If he is owner of the farm then, of course, its value would be an important item in the valuation.

As regards the tabulating of the various items in the valuation, little need be said. It is a very simple matter to arrange a method of classifying the valuations which will best suit the system of book-keeping in operation and examples are given in all the regular text-books on farm book-keeping.

**A NEW METHOD FOR THE
DESTRUCTION OF BACTERIA IN LARGE
VOLUMES OF MILK BY MEANS
OF ELECTRICITY.**

FREDERICK C. LEWIS, F.C.S.,

*Assistant Lecturer in Bacteriological Methods in the University
of Liverpool.*

*(From the Bacteriological Department of the City and University
of Liverpool.)*

THE method described in this article for rendering harmless the bacterial contamination of milk was evolved in an attempt to sterilise milk more efficiently, from a public health point of view, than is possible by the ordinary methods of steam sterilisation.

The essential feature of the method consists in passing a suitable current of electricity through the milk during its passage through a tube connecting a container with a receiving vessel. The electric current so acts that the major portion of all bacteria in the milk is killed, and no chemical alteration in the milk so treated has been observed.

The method may be dealt with under the following heads :—

1. The electrical apparatus.
2. The essential dairy apparatus.
3. The manipulation of the apparatus.
4. The results obtained from a bacteriological point of view.
5. The cost of operating.

1. *The Electrical Apparatus.*—In the first place a suitable supply of electricity must be available or, if not ordinarily available, must be generated. The amount of current used is, of course, dependent upon the size of the apparatus, but the voltage must be normally between 2,000 and 3,000 volts. This current is applied to the milk by means of three electrodes made of copper, and each enclosed in a glass receptacle, or electrode chamber. The electrode chambers communicate with each other by means of stout glass tubing of even bore. The electrode chambers and the intermediate portions of glass tubing are connected by socket joints of india-rubber; the whole being built in sections, and fastened in this manner to facilitate cleaning, and to render the apparatus somewhat flexible. The bore of the glass tube or "lethal tube" is strictly relative to the milk output per hour of the particular installation, and the size of the electrode chamber and its

enclosed electrode is such as to interfere as little as possible with the flow of milk through the apparatus, and, in addition, to allow the copper electrode to command the whole bore fully, so that no milk can escape through the apparatus without being submitted to the full action of the current. The electrode is made of copper, about $\frac{1}{8}$ in. thick, and is connected with the electric cable by means of a flat plate, which, by spring contact, is forced against a similar flat plate directly connected to the electric cable. As previously indicated, a high tension current is used, thus necessitating in commercial use the addition of various devices to render the apparatus safe to the operator. Prior to its entry into the lethal tube the milk flows through an aluminium tube ; similarly, as the milk leaves the apparatus it flows through a second aluminium tube, both tubes having a direct earth-connection. Such an arrangement prevents any leakage of current into the containing or receiving tanks. Those handling the milk before and immediately after treatment are, therefore, secure against shock. The lethal tube, with its high voltage connections, is mounted on a slate panel, itself suspended from the back of a glass-panelled upper cupboard. A lower cupboard, the doors of which are automatically closed by the overlapping doors of the upper cupboard, contains the high voltage transformer. A further protection is here introduced. In the framework of the two doors of the upper cupboard switches are placed, which, when the doors are open, are "off," but when the doors are closed are "on." These switches are connected directly with the source of the electric current. When, therefore, the doors are open, the electric current is of *necessity* "off," and the apparatus can only be worked when the doors are closed ; the act of opening any of the doors automatically disconnects the electric current. Thus the apparatus is perfectly safe, even when worked by an operator not specially skilled in the theory and practice of electricity. The electricity used normally consists of a low voltage alternating current obtained from the town's mains, or specially generated ; this is then passed into a transformer, and the voltage increased to the desired point. Switches, and other controlling gear, are mounted on a switch board from which the whole of the apparatus is worked.

A sectional diagram of the lethal tube and its auxiliary portions is shown on p. 1231.

2. *The Dairy Apparatus.*—The essential dairy appliances at present in use with the apparatus are indicated as follows :—
(See diagram).

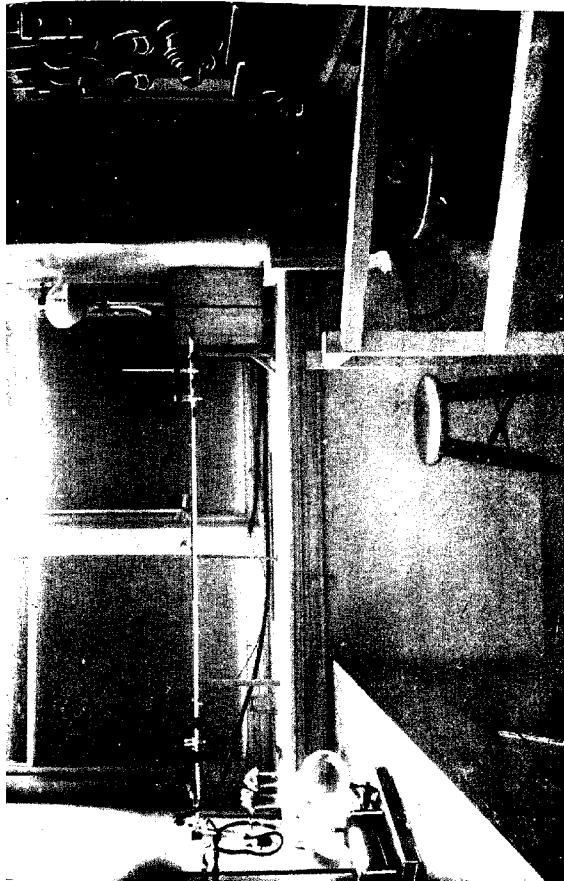
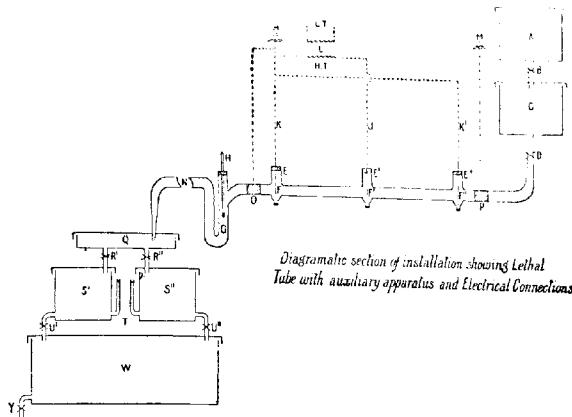


FIG. 1.—Photograph of experimental apparatus used in the bacteriological laboratories. On the extreme right of the photograph is the switch board upon which the motor and dynamo, and upon which the room can be regulated. The current to and from the transformer (visible in lower right-hand corner) is also controlled at this board. On the ledge in front of the window, from right to left, the following points can be observed:—(1) Bulb containing supply of milk; (2) Thermometer for indicating temperature of incoming milk; (3) Electrode and Electrode Chamber; (4) Length of a lethal tube; leading to the central electrode. After this point a bend occurs in the tube, but the third electrode chamber can be seen on the left with thermometer and outlet for treated milk leading into a tank. The thick high-tension cables may also be seen, with thin cable connection to the electrodes.



GUIDE TO LETTERING ON DIAGRAM.

A = covered receiving tank for untreated milk; B and D = taps; C = constant level tank; E, E' and E'' = electrode chambers; F, F' and F'' = electrodes; O, P = aluminium earthing tubes (the portion of the apparatus between O and P is the "Lethal tube"); K, K' and J = electric cables; L = transformer; LT and HT = low and high tension; M = earth connections; H = thermometer; G = thermometer holder; N = outlet pipe from lethal tube; Q = covered channel leading through tapped pipes; R, R' to S' and S'' = auxiliary tanks; T = level gauges; U' and U'' = outlets from auxiliary tanks; W = Main tank for treated milk; Y = outlet.

A covered main receiving tank (A) discharges through a ball valve into a constant level tank (C). From the latter tank the milk flows by gravity through the lethal tube where, as previously stated, bacterial destruction takes place. From the lethal tube the milk passes through channel (Q) into the small auxiliary testing tank (S'); when this tank is full the flow is diverted into testing tank (S''), and milk from (S'') is discharged into the main container (W), and so on, (S') and (S'') being used alternately. From the main container (W) the milk may be cooled, and used or bottled as the case may be. The object of the auxiliary testing tanks is explained below. The receiving tanks, etc., must, of course, be sterilised before use.

3. *Manipulating the Apparatus.*—Having made certain that all joints, etc., are tight, and the electrical contacts true, the constant level tank is charged and the milk allowed to flow through the lethal tube. The milk is discharged into a separate tank, and the flow regulated to approximately the correct speed. The current is now switched on and regulated to the correct dimensions. When the flow is

established at its correct speed the temperature of the milk will rise to the normal maximum, and the sterilising process will commence. The milk, now being treated, is allowed to flow for a few minutes, and is then diverted into the first auxiliary tank. The milk used in thus tuning up the apparatus can now be returned to the unsterilised supply. This preliminary manipulation ordinarily requires seven or eight minutes, or perhaps less, for its completion. The process, having been established, the apparatus does not need much attention, the work proceeding almost automatically. The flow, of course, must be unimpeded, and the electrical conditions must be regulated from time to time in order to cope with the slight variations which inevitably occur. These variations are dependent upon minute alterations in the flow and varying electrical resistance of the milk, and other similar factors beyond the control of the operator. If the flow of milk be impeded to any extent, the thermo-electrical balance is upset. When the alteration in flow is only temporary the electrical regulators may be suitably adjusted, and interruption in sterilising efficiency is avoided, but if debris, etc., cause a sudden holding up of the milk, the adjustments may not be made quickly enough, and "flashing" may occur in the tube. This would cause the milk to acquire a burnt taste; so that for this and for other uncontrollable factors the small auxiliary tanks (S'), (S'') are introduced in order that, if any milk be spoiled, or if any milk pass through the electrode chambers without being efficiently treated, it is trapped in one of these tanks, and consequently does not come into contact with the main bulk of the treated milk, and, if unspoiled, may be returned to the untreated supply. These small vessels, therefore, represent precautionary emergency measures, but it is only fair to say that they are very rarely needed. In England it is not necessary to cool the milk after treatment unless it is to be used in bulk; but although not necessary, it is perhaps advisable for reasons which will be apparent later.

4. *The Results of Bacteriological Examination of Treated and Untreated Milk.*—All milk contains bacteria, and the problems associated therewith are due to two general factors:—

- (a) The number of bacteria actually present in the milk, and
- (b) the types of bacteria present.

These two factors may be regarded from the standpoint of the milk retailer, and from the standpoint of those engaged

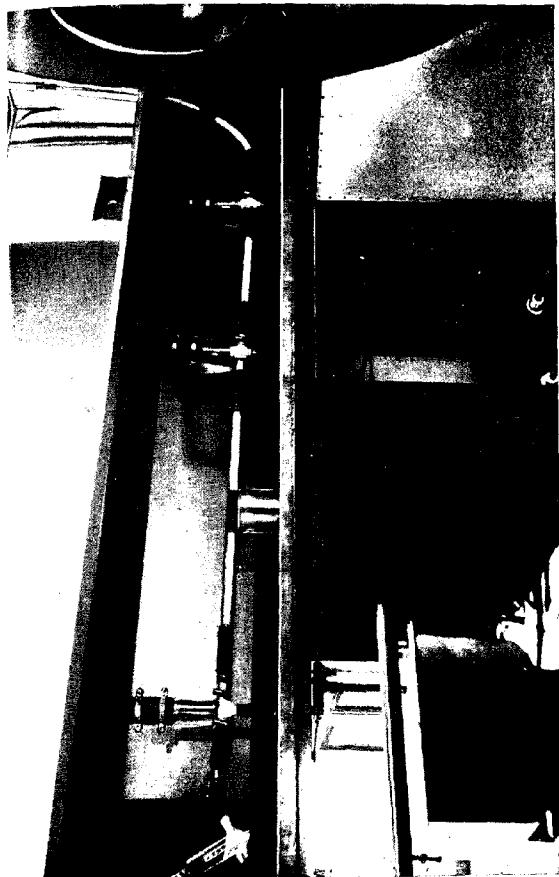


FIG. 2.—The lethal tube, full of milk, can be seen in this photograph, together with three electrode chambers and electrode brackets with curved supporting claws. The inlet tube on the right and the outlet thermometer on the left are also observable. Terminals of the transformer are shown in the asbestos-lined cupboard below, white in the lower left-hand corner is one of the auxiliary tanks, with the testing trough immediately above it. Immediately to the right and left of the first and last electrodes, respectively, are shown the aluminium earthing tubes. Owing to the limited space at the disposal of the photographer, a more comprehensive view could not be obtained.

in public health work, or those who use the milk for the manufacture of secondary products. The standard of efficient sterilisation must, therefore, take into consideration the

TABLE I.

Date.	Control Sample* (untreated milk)		Electrically Treated Milk 1 c.c.
	Bacteria present (grown on agar at 37° C.)	Bacteria present (grown on agar at 37° C.)	
January 26th, 1914	...	777,000	642
" 27th, "	...	Uncountable.	327
" 28th, "	...	123,400	53
" 29th, "	...	158,400	189
" 30th, "	...	568,000	316
" 31st, "	...	567,600	168
February 2nd,	...	80,000	100
" 3rd, "	...	97,500	16
" 4th, "	...	126,500	22
" 6th, "	...	35,400	0
" 8th, "	...	96,400	87
" 10th, "	...	152,400	130
" 12th, "	...	112,200	75
" 13th, "	...	19,840	348
" 14th, "	...	950,000	49

TABLE II.

Date.	Control Sample* (untreated milk)		Electrically Treated Milk 1 c.c.
	Bacteria grown on neutral red agar at 37° C. (<i>B. coli</i> , &c.)	Bacteria grown on neutral red agar at 37° C. (<i>B. coli</i> , &c.)	
January 26th, 1914	...	1,140	0
" 27th, "	...	180	0
" 28th, "	...	1,320	0
" 29th, "	...	29	0
" 30th, "	...	636	0
" 31st, "	...	912	0
February 2nd,	...	600	0
" 3rd, "	...	798	0
" 4th, "	...	105	0
" 6th, "	...	436	0
" 8th, "	...	25	0
" 10th, "	...	17	0
" 12th, "	...	676	0
" 13th, "	...	96	0
" 14th, "	...	432	0

* The "Control" sample is in each case a sample of the milk taken prior to electrical treatment.

destruction of bacteria as influencing the "keeping quality" of the milk, and the destruction of special bacteria of importance from the public health aspect, or the aspect of the manufacturer of milk products.

It is not altogether wise to judge the efficiency of a sterilising process merely by noting the percentage bacterial reduction, for the more impure the milk supply the larger will be the percentage reduction by any "sterilising" process, and this percentage reduction may well be accompanied by the survival of the more important or dangerous bacteria present. Some representative bacteriological results from each of these standpoints, as obtained by the electrical method, are, therefore, briefly indicated on p. 1233.

It will thus be seen that, judged from the standpoint of the percentage reduction, the electrical method gives highly satisfactory results, over 99.9 per cent., and judged from the standpoint of the presence of *B. coli* (or manurial contamination) the results could not be improved.

The importance of the absence of *B. coli* and allied organisms is obvious, for it means, amongst other things, the almost total absence in treated milk of the ordinary acid-producing bacilli, and the abolition from the milk of the type of organism associated more or less intimately with infantile diarrhoea. Considerable evidence has also been collected as to the lethal effect of the process upon the organism of tuberculosis.

Effect of Electrical Treatment on B. Tuberculosis.—The experiments were conducted with artificially infected milk and with milk obtained from tuberculous cows, as occasion arose, with both the smaller experimental apparatus and the larger plant at the milk depot.

Passing notice may be given to an experiment in which some milk was heavily infected with fresh human sputum containing very numerous tubercle bacilli. After electrical treatment the centrifuged deposit from the milk was injected into guinea pigs. These animals were killed at the expiration of six weeks, and no trace of tuberculous infection could be found. The control animals, which had been inoculated with the untreated mixture, however, died from sepsis in a few days after inoculation, hence the result, so far as tubercle is concerned, was inconclusive. Apart from this, the result is of importance as showing the general destruction of the other pathogenic organisms, which it will be seen were present in the sputum or the milk in sufficient numbers to cause the rapid death of the control animals.

Experiments on Naturally Occurring Tuberculous Milk.-- In April, 1913, milk from a known tuberculous cow was passed through the electrical apparatus; the velocity of the milk was somewhat high, and the amount of current used was small. As was expected, both the control and experimental animals developed well-marked tuberculosis. This experiment being designed to observe the effect of increasing the intensity of treatment, part of the sample was reserved for inoculation, and the remainder then retreated. Again a portion was reserved for inoculation tests, and the remainder given a further treatment. In neither of these cases did the animals inoculated with the treated milk show any signs of tuberculosis.

These results would appear to offer conclusive evidence as to the destruction of tubercle bacilli, and, in addition, serve to illustrate the need for *adequate* treatment of the milk. It is possible, but highly improbable, that, despite apparently efficient mixing, by a series of remarkable coincidences, the milk in the two later stages of the experiment was in each case non-tuberculous owing to the unequal distribution of tubercle bacilli, and that infecting doses were present only in the portions reserved for inoculations in the first stage of the experiment and the controls. Admitting, for the sake of argument, the correctness of the above, the following experiments are of considerable importance:—

A litre sample of milk was obtained from a cow known to be tuberculous as determined by previous animal inoculation of the milk. This was thoroughly mixed and divided into two equal parts, one of which was electrically treated under normal electrical conditions, and the other was left untreated. The "treated" and "untreated" portions were then dealt with as follows:—

500 c.c. of each was taken and centrifuged as ten separate 100 c.c. samples; the cream and deposit of each 100 c.c. were then injected into guinea pigs, five with the deposit and cream from untreated milk and five with the deposit and cream from treated milk. At the end of the necessary period the animals were killed and examined, with the following results:

TABLE III.

<i>Untreated Milk.</i>	<i>Treated Milk.</i>
Guinea pig No. 1 }	Guinea pig No. 1 }
" " 2 }	" " 2 }
" " 3 }	All were killed and examined most
Tuberculous.	minutely, but no
" " 4 }	" " 4 }
" " 5 }	" " 5 }
	trace of tubercu-
	losis could be found.

Thus there is definite evidence of the destruction of all tubercle bacilli, and this under conditions of infection not likely to be met with in practice. It will be noticed that the milk was the product of one tuberculous cow, whereas the milk supply of a dairy or sterilising depot is the mixed milk of many cows, with, therefore, a corresponding reduction in the relative number of tubercle bacilli.

Experiments on Artificially Infected Milk.

1. A sample of milk was freely infected with an emulsion of living bovine tubercle bacilli. After the milk had been thoroughly mixed, two control

animals were inoculated. The remainder of the milk was then treated under "normal" electrical and other conditions and a further two animals injected with the treated milk.

The results were as follows :—

- (a) The animals inoculated with untreated milk developed tuberculosis.
- (b) The animals inoculated with electrically treated milk showed no signs of tuberculosis.

2. A sample of milk was sterilised by steam in the autoclave and afterwards infected with the caseous glands of a tuberculous guinea pig; the infected material was added to the milk in the form of an emulsion made by the aid of a pestle and mortar. This artificially infected milk was then electrically treated. The result was as follows :—

- (a) A guinea pig inoculated with untreated infected milk developed well-marked tuberculous lesions.
- (b) Guinea pigs inoculated with infected milk after electrical treatment, showed no sign of tuberculosis on post mortem examination.

Further Evidence of the Destruction of the Tubercle Bacillus.—During the testing of a large scale plant further evidence was obtained as regards the destruction of tubercle bacilli. Deliberately infected milk was not used, for the apparatus was built in ordinary dairy premises, but on several occasions the untreated milk was found to be tuberculous, and the corresponding sample of treated milk was non-tuberculous. In those cases where the untreated samples were non-tuberculous, the corresponding electrically treated samples were also non-tuberculous.

TABLE IV.

Showing the Destruction of Tubercle Bacilli by Large Scale Electrical Apparatus.

	<i>Date.</i>	<i>Untreated Milk.</i>	<i>Electrically Treated Milk.</i>
January	31st, 1914		
February	10th, "		Inoculated guinea pigs were
"	11th, "		killed, and on post mortem examination showed
"	16th, "	Tuberculous	no trace of tuberculosis.
"	24th, "		
March	10th, "		
"	24th, "		

It is interesting to observe that some of the animals inoculated with untreated milk died from septic poisoning, the result of bacterial impurities present in the milk, but that no deaths occurred when the animals were inoculated with the milk after it had been treated, except in one case, and that obviously due to other causes.

It would thus appear that this apparatus is in general terms capable of effectively dealing with milk in such a way as to kill the greater portion of all bacteria present, and to destroy the tubercle bacillus, and other pathogenic organisms which may be ordinarily present.

The next point which should be emphasised is that this is accomplished without any alteration in the chemical constituents of the milk so far as can be ascertained by authoritative

chemical analyses.* There is absolutely no change in the taste of the milk. This is shown by the fact that expert dairymen (English and foreign) have been unable to distinguish, as regards taste, between treated and untreated milk. The enzymes or ferments in the milk are not destroyed by the electrical treatment.

Such, then, are the main features of the process briefly discussed; there are, however, several other points which may now be referred to.

A study of the table of results previously quoted will show that, although the bacteria are very greatly reduced in numbers, the milk is not sterilised in the strictest sense. Many groups of bacteria are always wholly destroyed, e.g., the *B. coli* group, but certain other groups appear to contain a few individual members which are highly resistant to the electrical action.

These few remaining organisms will, therefore, ultimately produce changes in the milk, but these changes are always much delayed. Even in the hottest weather in England the milk is perfectly fresh for 3 or 4 days after treatment. The change which ultimately takes place is a characteristic one, viz., mild, pleasant, acid reaction and flavour. The putrefaction which is noticeable so often in stale steam "sterilised" milk has never been observed. This is of considerable importance, not only from an agricultural point of view, but also from the standpoint of infant feeding.

Now that so-called pure-culture ferments are being extensively used in the butter and cheese making industries, it is interesting to mention that milk treated by this electrical process is perfectly suitable as a medium for the action of culture ferments. This has been proved upon several occasions in the laboratory, and also in a special series of experiments made independently in an English margarine factory, where most of the trade ferments were available.

Samples of the treated milk were also submitted to a butter manufacturer, who tested their butter-forming characteristics. His report was that the milk was perfectly satisfactory, both as regards the quality and quantity of butter obtained from it.

5. *The Cost of Operating.*—The apparatus is of a practical nature, and does not require highly skilled labour to work it. That the plant is capable of continuous use is assured, for the power plant is of an ordinary description, and there are no moving parts of the lethal tube. The design is relatively simple, and spare parts are cheap and easily

* See Reports by W. H. Roberts, City Analyst, Liverpool.

fixed. To take to pieces or assemble the apparatus is the work of a few minutes, and cleaning is very easily accomplished. The particular large-scale experimental plant described in this article is of normal design, and was operated daily for three months, during which time some 9,000 gal. of milk were treated and distributed into about 270,000 bottles for infants' use.

The power unit used was an electric motor, but steam, town's gas, or producer gas may also be used. The total cost, including interest and depreciation, wages, and fuel, where electricity at 1·5*d.* per unit is used, is 1·25*d.* per gallon. In the case of town's gas at 2*s.* 8*d.* per 1,000 cubic feet, the total cost is reduced to 1·96*d.* per gallon, and is again reduced to 1·85*d.* per gallon when producer gas, obtained from anthracite at 3*s.* per ton, is used. The amount of electricity used is about .43 units per gallon of milk.

In conclusion, the author wishes to express his best thanks to Professor J. M. Beattie, M.D., for permitting him to refer to the experiments in which both are jointly concerned (particularly those relating to the effect of the process on the tubercle bacillus), and for his ever-ready advice and valuable criticisms, and to the Town Clerk of Liverpool for permission to use the blocks for Figs. I. and II.

DESTRUCTION OF RATS IN EAST LOTHIAN.

WILLIAM LAW.

IN a paper on "The Farmers' Pests," read before the East Lothian Farmers' Club in 1909, Mr. A. G. Spence pointed out that rats breed 5 or 6 times in a season, and bear from 5 to 10 young each time, while the young begin to breed when about 6 months old. Mr. Spence was of opinion that the number of rats was increasing, and this he attributed mainly to the killing of owls and kestrels, the natural enemies of the rat.

As a result of this lecture, the Club was satisfied that individual and spasmodic efforts at destroying rats were of little use, and that concerted measures were necessary, because rats when unduly harassed at one farm migrate to another. At a meeting of landowners, land agents, shooting tenants and farmers, called to consider the matter, it was decided to appoint a Standing Committee to receive subscriptions and engage rat-catchers, and it was entrusted to Mr. John Stirling, the

Secretary of the Club, to draw up a scheme of organisation for the county. This was done by dividing the county into districts, and allotting to each district as many parishes as it was considered a killer could effectively cover in the course of a winter. It was arranged that in each district the killer should be supervised by someone voluntarily undertaking the work and not simply by the farmer on his own farm. The subscription was at the rate of 1*d.* per £1 of rental, or, alternatively, 10*s.* per 100 acres. Most of the landowners whose tenants joined the scheme contributed towards its support. Killing was effected mainly by the use of traps, dogs and ferrets. Poison was employed only at the request of the tenant or the owner's gamekeeper.

Operations were started in the autumn of 1909 with 4 men, paid at the rate of 25*s.* each per week, with 1*s.* 3*d.* extra for the maintenance of each dog. The Committee provided each man with about 6 doz. traps, 2 ferrets and 2 dogs.

On the whole, the scheme worked satisfactorily. The area subscribed for was covered twice between 1st November, 1909, and 30th April, 1910, and the Secretary was able to report—(1) That the voluntary assessment and proprietors' subscriptions amounted to £157 6*s.* 1*d.*; (2) that the expenditure on traps, dogs and licences, wages, printing, etc., was £148 14*s.* 2*d.*; and (3) that the rats killed, apart from those destroyed by poison and 650 killed during the threshing of 7 stacks at one farm, numbered 9,486.

In the following year two killers, by means of traps and dogs, accounted for 6,858 rats between 1st October, 1910, and 26th April, 1911.

In the summer of 1911 the County Council agreed to take over the work of the original Committee and to charge the expense to the Public Health rate. A Joint Sub-Committee was formed, consisting of representatives of the Eastern and Western District Committees of the County Council and of the Farmers' Club, and the writer was asked to supervise the killers. With the consent of the County Council the Sub-Committee acquired the traps then belonging to the Farmers' Club and proceeded to take all necessary steps for the effective and systematic destruction of rats in the county. The county was divided into 7 districts, and 7 rat-killers were engaged at a wage of 30*s.* per week. Each killer was required to supply himself with 2 dogs. The Joint Sub-Committee held meetings periodically, at which accounts were passed and reports as to the progress of the scheme submitted.

In the period between 1st October, 1911, and 5th October, 1912, the 7 killers, by means of traps and dogs, destroyed 29,804 rats at a cost to the rates, in round figures, of £450, or $\frac{1}{2}d.$ per £ on the rental, payable one-half by owner and one-half by occupier. The Western District Committee of Haddingtonshire County Council dropped out of the scheme in 1912, and since then the Eastern District Committee have continued to work in their own area at a yearly cost of about £240, necessitating a rate of about $\frac{7}{8}d.$, payable one-half by owner and one-half by occupier.

Three rat-killers are now employed at a wage of 30s. per week under the supervision of the writer, the killer providing and maintaining his own dogs and ferrets.

In 1912 it was decided that the men should be employed throughout the whole year, as it is difficult completely to kill off the rats in the winter when the homesteads are occupied by stock. The new arrangement also enables the killers to attend all threshings, the importance of which will be realised when it is mentioned that one killer, during one month in the summer of 1913, accounted for 1,000 rats.

All rats killed are taken to a convenient centre near the farm, where they are counted over in the presence of the farmer or his steward. The numbers are then entered in the rat-killer's book in duplicate. The farmer or steward signs the book and retains the duplicate. The book is handed to the clerk of the Eastern District Committee of the County Council on pay day, once a month, when the figures are checked.

During the last 3 years the following numbers of rats have been killed:—

Year ended 25th October, 1913	...	...	20,708
" 24th " 1914	...	...	23,625
" 23rd " 1915	...	...	25,636

This makes a total of 116,857 rats killed between 1st November, 1909, and 23rd October, 1915, most of these having been killed during the last 4 years.

Most of the foregoing particulars are taken from an article by Mr. John Stirling.*

Method of Working.—The way in which a rat-killer works may now be briefly described. There is allotted to each man a "district," comprising from 25 to 30 farms, chosen so as to be conveniently worked from the rat-killer's headquarters, which are situated, as a rule, near the centre of his area. The man

* "Notes on the Destruction of Rats in East Lothian," *Transactions of the Highland and Agricultural Society for Scotland, 1914.*

begins with the outer farms and gradually works towards the centre.

Trapping.—Eight doz. light steel traps of saw pattern, with chains attached, are supplied to each man, and 4 doz. can be conveniently carried about at one time. A sufficiency of traps is of great importance, especially during the first and second nights, when, owing to the novelty of the proceedings, the largest numbers of rats are usually caught.

The man moves about among his traps, disposing of the rats as they are caught, and in this way he is able to cover a large part or even the whole of a homestead in the first night. If the homestead is a large one, and two nights are required to complete the catch, the rat-killer takes the lee side first in order that the squealing of trapped rats may be prevented, as far as possible, from reaching those on the other side of the homestead. The traps are set in the usual way, amid the favourite haunts of the rat, and are usually covered with a little oat or barley chaff, care being taken to use the hand as little as possible in the process and to mask the human "smell" by rubbing the hand with soil. If bait is used it may be composed of oatmeal or bread crumbs mixed with an equal proportion of mutton fat from "fallen" sheep; or a little of such mutton may be roasted for the purpose. As the rat is a cunning animal an occasional change of bait is desirable. At day-break all the traps are sprung to avoid accidents with poultry or other domestic animals. Cats should be kept in confinement during the night.

Many rats are also trapped in open ditches, particularly in the vicinity of stackyards or potato clamps. The trap is set close to the water, with the outer edge of the plate next the bank. No covering is needed. The rat is caught as it runs along the water edge. This is one of the surest "kills" in rat-catching.

Ferreting.—When not pressed with night work the rat-killer is able to continue operations during the greater part of the day; with his two dogs, ferrets, and a spade he proceeds to search the hedge-bottoms, his dogs being trained to run one on each side of the hedge. In this way one dog or the other is sure to get the "wind" of any rats that may be lying up. Sometimes a rat will successfully face a ferret in a hole and thus protect several other rats behind. In such circumstances digging out becomes necessary. When the man is digging, one of the dogs remains on guard on the opposite side of the hedge. The dogs most suitable for this purpose are Irish,

Airedale or Rough-haired Fox Terriers. For digging out rats the best spade is a light handy tool, clasped nearly up to the handle, with the "business" part not more than $3\frac{1}{2}$ in. broad and 7 or 8 in. long, and kept well sharpened. If it is found impossible to dig the rats out, or "bolt" them, traps may be set during the day and, to safeguard game from capture, should be covered with light spruce branches or a handful of long grass. If the trap happens to be sprung by a bird, the bird will be thrown upwards. (Dogs soon learn to avoid the traps.) The covering is quickly removed in the evening by means of a small stick.

Rats are often very plentiful in summer and autumn in the hedgerows, whither they are attracted by the grain crops. Other favourite haunts in the field are the potato clamps, which abound in this county. The rats burrow their way in, and not only consume considerable quantities of potatoes, but expose the tubers to the risk of damage by frost. Clamps are generally ferreted, and as several rats usually bolt at once care is taken to shut up all holes in dykes, ditches, etc., in the vicinity, in order to facilitate the work of the dogs.

Stacks may be ferreted successfully in the daytime.

Killing when Threshing.—Threshing operations often provide excellent opportunities for destroying large numbers of rats. Each stack, as it is being threshed, should be surrounded by rat-proof wire netting, held in position by suitable supports about $4\frac{1}{2}$ ft. long and tied securely at the bottom. This gives the dogs an excellent chance: a man also, with a stick, can make a thoroughly clean kill.

Use of Lights.—The writer has never been able to entice rats out into the open with a light of any kind, but has often killed considerable numbers in stables and granaries by suddenly flashing a bright light in their midst; this seems to stupefy the rats and gives a dog an opportunity to kill several before the rest recover from the shock. The flashlight method is very effective on stacks. The rats come to the outside at night, and if a strong light is suddenly flashed on them they can be whipped off with a long stick for the dogs to destroy. As many as 50 at one farm have been killed in this way in a single night.

Flooding.—A good old-fashioned method of killing rats about stables, cow-houses, piggeries, etc., is by flooding. The traps of the drains are stopped up and water is turned on through a hose. The entrance of water into their holes causes the rats to bolt, when they fall an easy prey to dogs.

Rat Virus.—Rat virus, after a trial, was discontinued, as many diseased-looking rats, covered with scabs and without hair,

were to be seen running about from time to time. This, to say the least, was undesirable.

Poisoning.—Killing by poison is sometimes adopted if in the opinion of the rat-catcher and the farmer such a course is desirable. The poison is provided by the County Council, and consists of preparations either of arsenic or of strychnine with oatmeal or maize meal. The rats are fed with meal only for the first 3 nights, then the poison is added. By using meal as the poison medium the rats are unable to carry away pieces which may afterwards be discovered by other animals. If, after poison has been used effectively, the rat-holes are run with gas tar the farmers' premises will remain free from rats for many a day.

During a hard winter, when rats are often short of food, poison may be very effective, but whether poison be used or not it is always advisable to take advantage of a covering of snow to follow up the tracks left by the rats.

There is always, however, a certain amount of danger connected with the use of poison. It seems to create an insatiable thirst, and the rats invariably hang about water courses, wells, etc., and frequently topple in and die in the water, with results that may prove most serious to the public health.

Use of Birds and Animals.—In connection with the suppression of rats, owls and cats often play a prominent part. Some cats, however, are quite useless, while others are invaluable. One summer evening, after a shower, the writer saw 3 owls and 1 cat kill as many as 30 rats in about an hour. The rats emerged from some wheat stacks to catch the rain-drops on the thatch and were immediately "lifted" by the owls, while the cat picked off those near the ground. No gamekeeper who knows his business will kill cats anywhere in the neighbourhood of farms.

Weasels and stoats also kill a number of young rats, but they are seldom a match for a full-grown rat, especially a female.

The success which has thus far attended the East Lothian scheme is no doubt attributable largely to the type of rat-killer employed and the terms of his appointment. The best rat-killer, as a rule, is a retired gamekeeper, or a gamekeeper who is temporarily out of employment, as, for instance, through the changing of shooting tenants, but any one who is really keen will soon become a proficient rat-killer. As an occupation for disabled soldiers and sailors rat-killing is specially worthy of attention. At the present time one of our most skilled men has only one arm. Payment at the rate of so much a tail is

generally unsatisfactory, as under that system, after a man has secured the majority of the rats at one farm his natural inclination is at once to move on to another, leaving many uncaught. It is difficult, if not impossible, to exterminate rats, but continuous employment under a concerted and carefully-planned scheme will go a long way towards securing the desired end. It is not sufficient to confine attention to the farm buildings; the fields in summer and autumn must be thoroughly covered, and also the woods in winter where game are hand-fed, for wherever food is to be found rats invariably congregate. It is also important that the rat-killers should provide and train, if necessary, their own dogs and ferrets, in order that all may work together in complete harmony.

SUMMER SPRAYS AGAINST AMERICAN GOOSEBERRY-MILDEW.

Professor B. T. P. BARKER, M.A., and A. H. LEES, M.A.,
University of Bristol.

THE writers have summarised in the present note the work on the summer treatment of American gooseberry-mildew on which they have been engaged during the past two years. The results of this work, in the course of which liver-of-sulphur was used with varying effect, confirm generally the conclusion of Messrs. Eyre and Salmon which was given in the last number of this *Journal* (February, 1916) in an article on "A New Fungicide for Use against American Gooseberry-Mildew." In that article an account is given of experiments conducted during the past two years on means of controlling the American gooseberry-mildew. Messrs. Eyre and Salmon conclude that "Solutions of liver-of-sulphur of the strength generally recommended for use as a fungicide are quite inefficient against the American gooseberry-mildew: at a concentration at which the solution becomes fungicidal, such severe scorching injury is caused to the gooseberry bush as to preclude its use." This conclusion is of considerable importance, since, as is pointed out, liver-of-sulphur has hitherto been considered by many investigators as efficacious against mildews in general and American gooseberry-mildew in particular.

Trial has been made of a mixture which does not appear to have been previously used—a mixture of liver-of-sulphur and a

soft-soap-and-paraffin emulsion, which has given most promising results. How far the liver-of-sulphur is the active fungicidal ingredient has not yet been determined. Probably each of the three constituents is required for full effect. In any case the preliminary results have been so satisfactory that it is desirable to test thoroughly the effect of liver-of-sulphur used in this way before finally rejecting this substance for the treatment of the mildew, especially in view of the frequent use of this substance as a fungicide, and its convenience and cheapness for this purpose. The primary object of this note is to call attention to this mixture, as used in the 1915 experiments, in the hope that it may be tried by other workers during the coming season and its actual value tested under a variety of conditions.

The work was started at Long Ashton during the summer of 1914, in consequence of a slight outbreak of the disease in the plantations at the Research Station. It was decided to attempt to ascertain to what extent the disease could be controlled by summer spraying, the point of view taken being that if the summer stage of the disease could be adequately controlled the amount of the winter stage formed would be so limited that, with the further reduction of the latter by tipping, the outbreak the following season ought to be reduced eventually to insignificance. Details of the 1914 experiments having already been published,* only a short summary need be given here.

The procedure adopted in the first set of experiments on the affected bushes was to apply, firstly, a spray which would kill by direct contact so far as possible the *mycelium* and *conidia* present on the bush, and, secondly, a protective spray to keep the parts on which the fungus had thus been killed free from infection from external sources. A number of fluids of the first type, *i.e.*, "hitting" or "contact" sprays, were tested, including one composed of 4 lb. of liver-of-sulphur and 20 lb. of soft soap in 100 gal. of water. On each of the plots thus treated a series of protective or "cover" sprays, such as Bordeaux mixture, lime-sulphur, etc., were applied. The applications were made at the end of July, the outbreak being a very late one. None of the results was entirely satisfactory, the mildew reappearing fairly generally, although only slightly.

In the course of this experiment it became evident that the "hitting" sprays were all more or less ineffective, because they failed to wet the fungus uniformly owing to the presence of air

* Ann. Report of the Univ. of Bristol Agric. & Hort. Research Station, 1914.

between the *conidio-phores* and the *conidia*. The importance of this point has also been emphasised in the paper by Messrs. Eyre and Salmon, who, owing to this difficulty, used their test fluids made up with 1 per cent. of soft soap. The writers, however, found that twice that quantity of soft soap did not suffice to give complete wetting, when the fluids were tested on a practical scale. Under those conditions liver-of-sulphur in the 0·4 per cent. solution mentioned above proved inefficient. Messrs. Eyre and Salmon found that it failed in soap solutions of half that strength, when the percentages of the sulphur compound used were about the amount stated. It is, therefore, probably correct to conclude that liver-of-sulphur used at the rate of 0·3 or 0·4 per cent. in aqueous solutions or in soft-soap solutions is, at the most, of only limited value against mildews. (It is possible that a 1 per cent. solution might wet the less floury mildews, such as pea mildew, but fail with American gooseberry-mildew.)

The failure of soft soap alone to give the spray fluids under trial the necessary degree of wetting power led eventually to the use of soft-soap-and-paraffin emulsion. From previous spraying trials against Woolly Aphids on apple trees it had been found that with the comparatively hard water at Long Ashton the most wetting combination was an emulsion of paraffin in soft-soap solution at the rate of 20 lb. of soap and 2 gal. of paraffin to 100 gal. of water. With soft water not more than 15 lb. of soft soap need be used. This emulsion, both when used alone and when various fungicidal substances were dissolved in it, proved capable of completely wetting the densest patches of mildew. Even when a fungicide was not added to it, it appeared to possess a marked toxic action on the mildew, the *conidia*, so far as could be judged in the original trials by a microscopical examination, being killed after contact with it. The results of subsequent experiments tended to show that the emulsion alone could not be relied on to kill the "summer stage" completely, and on that account it was eventually decided after trial to use it in conjunction with liver-of-sulphur for the main 1915 experiment.

This experiment was an attempt to stamp out, if possible, the "summer stage" of the mildew from a fairly well-isolated gooseberry plantation in the neighbourhood of Weston-super-Mare, with the object of ascertaining if the disease would reappear the following season after this treatment supplemented by winter tipping, and, if so, if the time of the outbreak was delayed sufficiently for the fruit to escape infection.

The fungicide used was the soft-soap-and-paraffin emulsion referred to in a previous paragraph, with the addition of liver-of-sulphur at the rate of $3\frac{1}{2}$ lb. per 100 gal. of the fluid, *i.e.*, a 2 per cent. emulsion containing approximately 0.35 per cent. of liver-of-sulphur.* From the preliminary trials it appeared that, when applied with reasonable care, this fluid was capable of completely wetting and killing the mildew, and that at the same time it caused no scorching or defoliation and no disfigurement of the foliage or fruit.

The plantation treated consisted of bushes of Whinham's Industry and Keepsake, and was situated 100 yd. or more from the next plantation of gooseberries, in which the disease also occurred. The outbreak appeared in May, and by the beginning of June the berries and young-shoots of the Whinhams and the young shoots of the Keepsakes were freely attacked. The fruit of the former variety was largely covered with the summer stage and remained ungathered on the bushes throughout the course of the experiment. When the disease appeared to be at its height about the middle of June the spray was applied, care being taken to wet the whole of the bushes thoroughly. An examination of the diseased shoots and berries a few days later showed that the production of new *conidia* had ceased, and that the fungus originally present had apparently been killed completely.

It had originally been intended to spray the bushes again at intervals during the remainder of the summer; but, except for a very slight new outbreak on a few of the shoots of the outermost bushes of the Whinhams plot, no further growth of the mildew occurred. It was, therefore, considered unnecessary to give any further spraying.

There was no damage done by the spray fluid to the bushes except in the case of a few Keepsake plants, which received the last portion of the fluid. In this instance some scorching appeared and was evidently caused by too great a concentration of emulsion owing to lack of agitation in the knapsack machines used. On the few shoots which eventually showed the living "summer stage," the "winter stage" appeared also in due course. Very few *perithecia* were formed, and in none of those examined were ripe spores observed.

* The mixture is made as follows:—In 5 gal. of boiling water 20 lb. of soft soap and $3\frac{1}{2}$ lb. of liver-of-sulphur are dissolved by constant stirring. Two gal. of paraffin (preferably "Solar Distillate" brand) are forcibly sprayed into the hot solution, using a garden syringe with a rose attached for this purpose. For use add 19 gal. of water to every gallon of concentrated emulsion.

The critical test of the experiment is, of course, the reappearance of the disease and the time of the outbreak this summer. As to this, nothing can yet be said, but the experiment last year certainly serves to show that the liver-of-sulphur-soft-soap-paraffin emulsion is capable of drastically reducing the amount of the "summer stage" in an affected plantation and, provided that the spraying is administered as may be necessary, also of correspondingly curtailing the production of the "winter stage." Further than this conclusion it would be at present unwise to go.

It is probable that the character of the weather last season and the heavy crop of berries carried by the bushes prevented the formation of the succulent young shoots on the bushes which are mainly the object of attack, and that the spread of the disease from the few shoots which bore living *conidia* after the spraying was accordingly hindered. On this account no satisfactory conclusion can yet be drawn as to the number of sprayings required to keep the "summer stage" under control. Trials in a plantation of young, vigorously-growing bushes are required for this purpose.

The cost of the mixture at pre-war price per 100 gal. works out as follows:—

					s. d.
Soft Soap, 20 lb. at 14s. per cwt.	..	..	..	..	2 6
Paraffin (Solar Distillate), 2 gal. at 7d.	..	..	..	..	1 2
Liver-of-Sulphur, 3½ lb. at 8d.	..	..	..	..	2 4
Total	..	..	..	..	<u>6 0</u>

It should be remembered, however, that owing to its good wetting power less solution is used per bush than would otherwise be the case. With soft water 15 lb. of soft soap per 100 gal. would be amply sufficient, thus reducing the price to 5s. 4d. per 100 gal.

As to the mixture itself, it is believed that, where the treatment of the "summer stage" of mildew by a "hitting" fluid is concerned, the employment of a wetting fluid of the paraffin emulsion type is essential, and, so far as trials to date go, none approaches the 2 per cent. soft-soap-paraffin emulsion for effectiveness and cheapness combined. The choice of an active fungicide to supplement the toxic properties of this emulsion is still an open question, as indeed is the need for the inclusion of such a substance. Liver-of-sulphur was selected, to some degree arbitrarily, for the experiments which have been described, and appears to have acted very successfully: but further work may well show that there are better fungicides for the purpose. In this connection it will be interesting to test in its place ammonium

sulphide, the substance which has proved so promising in the experiments of Messrs. Eyre and Salmon. It seems possible that the effective results with the latter fungicide may have been due not only to its action in the form of a "hitting" spray but in part to its decomposition into volatile substances, which acted in a gaseous condition upon the fungus. Where "vapour" treatment is concerned the wetting properties of the fluid applied are not so vital, and 1 per cent. or less of soft soap in the mixture might then be adequate for effective distribution.

It remains to be added that the liver-of-sulphur-soft-soap-paraffin mixture probably possesses very limited protective properties against reinfection, and that renewed infection from outside sources can doubtless occur freely, even although the fluid may completely clear the plantation under treatment from the original "summer-stage" attack.

SILAGE AS FOOD FOR STOCK.

G. JAQUES.

ECONOMY in the production of milk and beef, and in the feeding of store cattle in winter, is a matter of first importance at the present time.

The value of roots as a succulent, nutritious and highly palatable food for stock is sufficiently attested by the fact that for over two centuries roots have formed the basis of winter rations. On heavy land and in a dry climate, however, such as prevail where the writer farms in Norfolk, the root crop is a very precarious one, and the question of finding a suitable substitute has exercised the minds of farmers for many years, and has latterly become a matter of extreme urgency. This problem the writer has solved to his entire satisfaction by introducing into the rotation an autumn-sown leguminous crop, which is made into silage in a modern stave silo. By this system milk is produced to-day at about 3½d. per gal. for food, or, roughly, half what it often costs when roots form the basis of the ration. By the same means the cost of producing beef and of keeping store cattle may also be correspondingly reduced.

Nitrogen being the most expensive manurial ingredient which a farmer has to buy, it must be sound economy to obtain the necessary nitrogen from the air, by growing leguminous plants every other year with the aid only of purchased phosphates.

Since its inception some years ago, this system of farming has given rise to much adverse criticism, but it is nevertheless a fact that several leading East Anglian farmers have adopted it, and speak most highly of the results. In view of the present scarcity and cost of labour, artificial manures and feeding stuffs, there is reason to anticipate a considerable extension of the system in the near future.

The following statement shows the cost of growing the silage crop and of producing milk by its use, in 1915:—

	£ s. d.
<i>Cost of growing one acre:—</i>	
Kent	1 0 0
Basic Slag	12 0
Ploughing	10 0
Harrowing	1 6
Seed (1½ bush. of tares, ½ bush. of beans, 1 bush. of oats, 1 peck of rye)	1 0 0
Seeding	2 0
Rates	4 0
Steam cultivating twice after crop is removed.	1 0 0
Rolling	9
	<hr/>
	£4 10 3

Cost of cutting and getting ready one acre for carting £0 11 0

Cost of filling silo 16 ft. by 39 ft., capacity 200 tons:—

	£ s. d.
8 men at 4s. per day for 6 days	9 12 0
3 boys at 1s. 6d.	1 7 0
5 horses at 3s.	4 10 0
Engine and driver at £1 per day for 6 days	6 0 0
Silage cutter at 15s. per day for 6 days	4 10 0
Coal	2 0 0
Beer	2 18 0
	<hr/>
	£30 17 0

Thirteen acres filled the silo to the top.

Cost of filling per acre = £30 17s. od. ÷ 13 = £2 7 6

Total cost of silage per acre:—

	£ s. d.
To grow	4 10 3
“ cut	11 0
“ fill	2 7 6
Interest and depreciation on silo, 10 per cent.	1 3 0
	<hr/>
	£8 11 9

Cost of silage per ton = 11s. 6d., or 16d. per lb.

Ration as fed to cows from 1st October to 31st December,

1915:—

60 lb. Silage	..	..	..	..	3·66d.
24 „ Turnips	..	..	..	..	1·28d.
1·6 lb. Concentrates (maize gluten at £10 per ton)	..	..	..	..	1·71d.
					6·65d

This ration fed to 17 Red Poll cows produced 32,254 lb. of milk from 1st October, 1915, to 31st December, 1915, or an average of 2 gal. per day, at a cost of 3·32d. for food per gal. The average number of days from calving, on 31st December, 1915, was 163, and the feeding of silage commenced on 20th September, 1915. The low cost per gal. was not obtained from cows at their "flush" of milk or through feeding a proportion of grass in the early period; it was due, presumably, to the high feeding value of the food that formed the base of the ration, and the small amount of concentrates.

The silage was analysed by Mr. Lincoln Sutton, the Norfolk County Analyst, with the following results:—

Moisture	..	..	..	..	61·31
Albuminoids	..	..	..	..	4·75
Indigestible Fibre	..	..	..	..	11·25
Mineral Matter (ash)	..	..	..	..	3·28
Volatile Acid (acetic)	..	..	..	..	·45
Non-volatile Acid (lactic)	..	..	..	..	·78
Digestible Fibre, Chlorophyll, &c.	..	..	..	..	18·18
					100·00

Yearling store cattle have been successfully wintered on 40 lb. per head per day of silage with only water in addition. Beef cattle fed on similar lines to the milking cows are reported to "dic" extremely well, being of good colour, firm, and of excellent quality.

Besides supplying a large bulk of valuable food at a low cost, the silage system has many other advantages, among which may be mentioned the following:—

1. The certainty of obtaining a crop.
2. The complete suppression of weeds.
3. The crop can be ensiled in June and July, when the land is generally dry and the days are long.
4. There is no risk of loss from frost as with roots.
5. The land is cleared early and is then made ready for turnips on suitable land, to be folded off. On the heavier soils mustard can be grown and ploughed in, or a bastard fallow taken.

6. A great saving of labour is effected throughout, as compared with roots.

7. More stock can be kept on the farm than is possible with a crop of roots; consequently more dung will be available. This, together with the residue of the slag and the nitrogen accumulated in the soil by the leguminous crop, is sufficient to maintain the land in a high state of fertility.

It may be well to add that since the adoption of the system by the writer 3 years ago (on a farm of 150 acres of second-class heavy land, comprising 105 acres of arable, worked on a four course rotation, and 45 acres of pasture) milk has been sent *once* daily to London, and no complaints of any kind have been made as to its flavour or quality. The wholesale firm to whom it is consigned report that the milk is of very good quality, testing in January last 3.90 to 3.95 per cent. of fat, and 8.81 to 8.86 per cent. of solids-not-fat.

Last year, although the barley yield is said generally to be very poor, the writer obtained 9½ sacks per acre, following the silage, without any manuring; the cleanliness of the straw was most noticeable. The barley was sold in the Norwich Corn Hall for 27s. per coomb (or 54s. per qr.), the top price paid that day being 28s. per coomb (or 56s. per qr.). The clover plant is very good.

Stock, not roots, are the foundation of a permanent, prosperous agriculture, and it is only by adapting or improving our methods as circumstances demand, that we, as farmers, can maintain or increase our stock and production generally.

THE ENCOURAGEMENT AND IMPROVEMENT OF LIGHT HORSE- BREEDING IN 1914-15.*

THE objects of the scheme initiated by the Board in 1911 for the encouragement and improvement of the horse-breeding industry have been so fully explained in previous issues of the *Journal* that it appears unnecessary to repeat them in a review of the operations for the year ending 31st October, 1915, but as, on the ground of economy, the Annual Report of the Board on the administration of the Light Horse Breeding Grant will not be printed and placed on sale as usual, it may be convenient to refer somewhat fully to the steps that have been taken during the year under review. The outstanding feature of the past

* This article replaces the Annual Report on the Administration of the Grant for the Encouragement and Improvement of the Light Horse-Breeding Industry for 1914-15, which will not be issued separately.

horse-breeding year was the opportunity afforded the War Office of ascertaining from their mobilisation experience the condition of light horse-breeding in the country.

Mobilisation and the consequent impressment of horses has proved—if indeed any proof was needed—that the hunting field is a national asset of the greatest value, providing, as it has done, a reservoir from which the Army has been able to draw a large supply of horses that are eminently suitable for military purposes.

The War Office experience has shown, also, only too clearly, that the civil horse stock of the country is deficient, not only in numbers but also in quality, to meet adequately military requirements on mobilisation. In spite of the fact that many of the finest horses in the world are produced in the United Kingdom it is very evident that we also produce in large numbers horses that are quite unfit for military needs and of little value for any other purpose. The necessity of improving and levelling up the civil horse stock of the country has been urged on the Board by the Army Council on military grounds, with the result that the President of the Board appointed a committee on 3rd August, 1915, to consider and advise as to the steps that should be taken to secure the production and maintenance in England and Wales of a supply of horses suitable and sufficient for military purposes, especially on mobilisation.

A full note as to this committee was given in the issue of the *Journal* for January last, but it may be well to recapitulate that their Report (Cd. 8134) was made to Lord Selborne on the 8th October last, and that their principal recommendations were:—

That the Board of Agriculture and Fisheries should—

1. Institute legislation to require compulsory annual registration by the Board of all stallions that are travelled for a service fee or publicly exhibited for stud purposes.
2. Increase the number of King's Premium Stallions.
3. Arrange for the inspection by their officers of stallions recommended for Board's premiums.
4. Continue the brood-mare scheme in those counties in which it has proved a success, and purchase high-class mares for re-sale to selected breeders.
5. Purchase stallions suitable for country service, and, if opportunity for doing so occurs during the present financial year, arrange to obtain the requisite funds.
6. Provide funds for the award of prizes for brood mares and foals.
7. Arrange for a compulsory annual census of horses in as detailed a form as possible, and for more complete returns of horses exported and imported.

8. Reconstitute the advisory council and county committees.
9. Appoint an expert staff of officers to supervise the scheme.

That the War Office should—

1. Purchase a much larger number of horses in England and Wales.
2. Increase their horse peace establishments.
3. Purchase more horses direct from breeders.
4. Purchase remounts when rising four.
5. Purchase specially-selected fillies and leave them with breeders until they have produced and reared foals.

The Board and the Army Council are in general agreement with the recommendations of the committee, and will endeavour to give effect to them as opportunity offers and funds are made available for the purpose.

The impressment of horses for military purposes naturally reduced the stock of mares in the country, and it was anticipated in some quarters that the shortage thus occasioned would militate against the success of the service seasons of the premium stallions. The Board themselves, however, did not share this view and they subsidised 90 instead of 78 stallions, as was the case in 1914, and it is satisfactory to be able to report that the number of mares sent for service in 1915 averaged 82 per stallion, an increase on the returns for any previous year. This increase was no doubt due to the fact that owners of mares anticipate that there will be a big demand at home and from abroad for horses when the War is over, and that it is, therefore, sound policy to utilise every suitable mare for breeding purposes. The reduction of the service fee of a King's Premium Stallion from £2 to £1 was also a further encouragement to mare owners to have their mares covered by the premium horses.

In connection with the anticipated scarcity of brood mares arrangements were made in 1915 for the return from France of mares which were not fit for hard military service, but which appeared suitable for breeding purposes. The mares were selected by an officer of the Board from among the horses in the veterinary hospitals in France, and after a month's rest and isolation at the Board's farm at Pirbright they were sold by auction on condition that they were not to be exported. Approximately 250 mares were so disposed of at an average price of £31, and it is hoped that the purchasers will utilise them for the purpose for which they were brought over, *i.e.*, for breeding.

Service Season, 1914.—Considerable difficulty is experienced each year in obtaining information from owners as to the foals bred from the mares that were served by the premium stallions,

although inquiries are made both by the Board and the owners of the stallions concerned. This difficulty was rendered more pronounced in 1915 owing to the fact that in 1914 a large number of mares which had been served by premium stallions, were purchased by the War Office.

The total number of mares served by the King's Premium Stallions was 3,820, as against 3,281 in 1913, and 2,127 foal fees were paid by the Board. The resulting percentage of foals was 58·09, practically the same as in 1913. Mares purchased by the War Office were not taken into account in calculating the foaling percentage, as no evidence was available as to whether or not the mares actually foaled down.

The average amount paid by the Board on account of a King's Premium Stallion was £254, and the maximum £291. These sums are slightly higher than for the 1913 season. With the addition of the service fee of £2 payable by the owner of a mare, the average earnings of a King's Premium Stallion were £356, and the maximum earnings £423. An additional payment of 100 guineas was made in respect of each of the 12 stallions to which Super-Premiums were awarded.

In addition to the Super-Premiums and King's Premiums above referred to, Board's Premiums were awarded to 28 stallions recommended by county committees, and of the 1,760 mares served 53 per cent. proved to be in foal. The average payments by the Board for each of these premiums was £113 and the maximum £150. With the addition of the service fee of £1 payable by the owner of a mare, the average earnings of a Board's Premium Stallion amounted to £157 and the maximum to £216. These figures are almost identical with those for the 1913 season.

Service Season, 1915.—*Super-Premiums and King's Premiums.*
—The Annual Show of Thoroughbred Stallions was held at the Royal Agricultural Hall, Islington, on the 2nd and 3rd March, 1915, the number of premiums awarded being 50 (including 12 Super-Premiums). The entries reached the satisfactory figure of 131, the highest on record.

The Judges were Mr. J. Simons Harrison, Sir Gilbert Greenall, Bart., C.V.O., and Mr. R. G. Carden, who in making their report on the Show said: "We have no hesitation in stating that, "in our opinion, it has exceeded all previous shows in the number "of high-class animals exhibited. All the stallions which gained "premiums were of the sort calculated to mate well with half-

"bred mares, and it is satisfactory to note that ten of these horses were new-comers, two gaining Super-Premiums."

The average value of the King's Premium was slightly increased, and the earnings of the stallion made to depend more on results than formerly. The service fee was reduced from £2 to £1, and the foal fee increased from 12s. 6d. to £2. The award of free nominations was discontinued.

The service arrangements of the stallions were supervised by voluntary local committees as in previous years, and their valuable help is much appreciated by the Board.

The number of mares served by the 50 stallions to which King's or Super-Premiums were awarded was 4,318—an average of 86 mares per stallion, which is a very high one when regard is had to the fact that the Board do not take into account or pay for more than 90 services for any stallion. The corresponding figures last year were 3,820 and 76.

Board's Premiums.—The number of Board's Premiums awarded on the recommendation of county committees was increased from 28 to 39, and, in addition, the Board's Thoroughbred Stallion "Adular" travelled at a service fee of £1 in the West Riding of Yorkshire. The average value of these premiums was also increased, and as in the case of King's premiums the earnings of the stallion were made more dependent on the results obtained. The foal fee was increased from 5s. to £1, the service fee remaining at £1 as heretofore. The stallions to which premiums were awarded comprised 31 Thoroughbreds, 7 Hunters, and 1 Cleveland Bay. Of the 31 Thoroughbreds, 9 had obtained King's Premiums in previous years while 21 had been exhibited at the London Show in 1915, and 14 of these had been awarded Reserve Cards. And as Reserves are awarded only to stallions of King's Premium merit, it will be noted that nearly half of the Board's Premium stallions were up to the King's Premium standard.

The total number of mares served by the 40 stallions (including "Adular") was 3,067, giving the very satisfactory average of 77 mares per stallion.

Riding Pony Premiums.—On the recommendation of the National Pony Society, premiums of the approximate value of £75 each were awarded in March, 1914, to 6 Riding Pony Stallions for the service of mares not exceeding 14.2 hands. The average number of mares served was 32, and the foaling returns show that the percentage of foals varies from 37 to 72.

Six premiums were again offered in 1915, but only 5 were awarded. The stallions gaining these awards travelled

respectively in the West Riding of Yorkshire, Cheshire, Warwickshire, Gloucestershire and Devonshire, and the average number of mares served by each stallion was 53. This is a distinct improvement on the results obtained the first season.

Premiums to Welsh Cob, Fell and Mountain and Moorland Ponies.—The premiums given by the Board for Welsh Cob Stallions of the old Welsh stamp to serve Welsh Pony mares that are entered in the Welsh Stud Book are much appreciated, and the number last season was increased to 13; 10 premiums were given in 1914 and 8 in 1913. The awards are made on the recommendation of county committees, and free nominations are allotted only to mares that are entered or accepted for entry in the Welsh Stud Book, and which have been passed by a veterinary surgeon as sound for breeding purposes. To Montgomery, Cardigan and Carmarthen 3 premiums each were assigned; to Brecon 2, and to Radnor and Merioneth 1 each.

Five premiums were awarded to Fell Pony stallions selected by judges appointed by the Fell Pony Committee. The stallions are required to serve mares of the Fell Pony type approved by representatives of the committee. The stallions travelled in the following districts:—Appleby, Middleton-in-Teesdale, Kirkby Stephen, Keswick, and Shap, and it is satisfactory to note that the secretary of the Fell Pony Committee reported that the eight entries for the show held at Keswick comprised the best class held under the Board's auspices, any one of the first six stallions being of sufficient merit for the premium. Five of these stallions had won premiums in former years.

The efforts of the Board to improve the breeds of mountain and moorland ponies are being well supported by the various local pony associations. The premiums, which are of the value of £5 each, are awarded only to stallions which are registered by the Board, and the stallions are selected for premiums by a judge appointed by the Board. Assistance is given only in districts in which regulations under the Commons Act of 1908 have been adopted and put in operation, and where associations have been formed to secure observance of the regulations, which prohibit the turning out on the commons of any entire horse, pony, or ass, unless it has been inspected and approved. Eleven premiums were awarded to stallions to roam the Eppynt Hills in Breconshire, eight in the Church Stretton (Salop) district, five in the Black Mountain district (Carmarthen), three in the Penybont district (Radnor), and four in Glamorgan (Fairwood and Pengwern Commons).

Ten premiums were again allotted to stallions to roam selected districts of the New Forest, and the secretary of the New Forest Pony Association wrote to the Board as follows:—

"We have got in the New Forest this year the best lot of suckers I have ever known, and I am pleased to say they are fetching quite 30 per cent. more money than they have for several years."

Purchase of Brood Mares.—This part of the horse-breeding operations was more or less suspended during the year under review so far as fresh purchases were concerned, as, owing to the large Army demands, the price of the mare of hunter type was very much inflated, and county committees wisely refrained from making many purchases. No grants were made to county committees, as in most cases they had more than sufficient balances to carry on, and also because it was considered that the sums available could be utilised by the Board to better advantage in subsidising additional stallions than in providing funds for the purchase of mares at high prices.

Registration of Stallions.—Since 1911 the Board have undertaken to examine stallions for registration free of charge, except in special circumstances, the object in view being the elimination of the unsound stallion which, travelling at a low service fee, enters into competition with premium and other subsidised stallions and does incalculable harm to the horse-breeding industry of the country. The success which has attended this part of the scheme has been most gratifying, and it is clear that owners of stallions now recognise the advantage and commercial value of Government certificates of soundness for their stallions. It is reasonable to infer, also, that owners of mares are beginning to realise that it is false economy to have their mares served by the first cheap and probably unsound stallion that is available when they can obtain the services of a premium or other registered stallion at a low fee. There is much to be said in favour of the compulsory registration of stallions and the advisability of initiating legislation for the purpose is receiving attention.

The number of stallions on the Board's Register has increased progressively from 313 in 1911 to 1,471 in the year under review. This year 103 stallions were refused registration, as compared with 106 the previous year, when the number registered was 1,220.

Of the 1,471 stallions registered this year, 768 were Shires, 219 Thoroughbreds, 167 Ponies, 131 Hackneys, 114 Clydesdales, 48 Suffolk Punches, 11 Hunters, 6 Yorkshire Coach Horses, 5 Cleveland Bays, and 2 American Trotters.

Of the 103 refused, 69 were Shires, 15 Thoroughbreds, 9 Clydesdales, 6 Ponies, 2 Hackneys, and 2 Suffolk Punches.

Fifty-nine of the refusals were in respect of stallions which had not previously been submitted for registration, and the remaining 44 related to stallions which had been accepted the previous year.

The ages of the stallions rejected for registration included all ages from 3 to 16 (inclusive), except 10 and 12. The ages of those passed sound in 1913-14, but rejected in 1914-15, are 4, 5, 6, 7, 8, 9, 10, 12, 13 and 22. A similar wide variation in the ages of the stallions rejected for re-registration occurred in 1913-14, which seems to strengthen the position taken up by the Board against the adoption of an age limit after which a sound horse should be given a life certificate.

The 103 stallions referred to above were rejected on account of the following diseases: Whistling (30), roaring (23), side-bone (14), cataract (12), ringbone (8), stringhalt (4), defective genital organs (4), bone spavin (4), shivering (1); whilst two stallions were refused on account of bad conformation.

Sixteen appeals were made against the reports of the examining veterinary surgeons, and it is noteworthy that only three of them were successful, as compared with seven out of fifteen appeals last year.

The Board wish again to acknowledge the support rendered to their registration scheme by the principal horse societies and their members, and they are glad to say that the Hunters' Improvement and National Light Horse-Breeding Society, the Hackney Society, the National Pony Society, and the Welsh Cob Society are continuing the veterinary examination of stallions at their shows in accordance with the schedule of diseases prescribed by the Board.

General.—The Branch has been occupied during the year mainly with correspondence, inquiries and other business arising out of the difficulties which have been ex-

The Work of the Commercial Control Branch for the Year 1915.*—The Board have experienced in connection with the transport of agricultural produce and requisites, with alleged contraventions of the Fertilisers and Feeding Stuffs Act, 1906, certain questions relating to the administration of the Sale of Food and Drugs Acts, 1875—1907, and offences under the Merchandise Marks Act, 1887.

* This article replaces the Annual Report of the Commercial Control Branch of the Board for the year 1915, which will not be issued separately.

Delay in Transport of Agricultural Produce and Requisites.—Many complaints of delay in the transit of goods by rail have been received. These delays have arisen from various causes. There has been a considerable increase of traffic due in part to the necessary requirements of the naval and military authorities and to the fact that the shortage of shipping and of labour on canals throws an additional strain on the resources of the railway companies. In a considerable number of cases it was ascertained on inquiry that the delay in delivery was not connected with difficulties of transport but was due to the fact that the consignor was not able to supply the goods.

In the case of agricultural requisites delay might often have been avoided if purchasers had ordered full truck loads. The advisability of ordering truck loads and placing orders in good time has been brought to the notice of agriculturists.

The action taken has been directed towards securing for agricultural produce and requisites the facilities which their importance in relation to the production of food requires at the present time.

Complaints have been investigated as far as possible and representations made to the Board of Trade, the Railway Executive Committee (consisting of the general managers of the railway companies, and appointed for the purpose of co-ordinating the resources of the railways in the general interests of the community), or to the railway companies concerned.

In some cases special instructions have been issued by the Railway Executive Committee, at the instance of the Board, directing that precedence shall be given to certain classes of agricultural traffic.

Conveyance of Fertilisers, Feeding Stuffs, Agricultural Seeds and Agricultural Machines.—Towards the end of the year anxiety was manifested by agriculturists as to the possibility of delay in the delivery of fertilisers, and it was urged that in view of the desirability that every effort should be made to increase the home production of food this traffic was more urgent than many other kinds. The Board accordingly requested the Railway Executive Committee to arrange that special attention should be given to the transport of fertilisers, and the Committee directed that such steps as were possible should be taken by the railway companies to prevent delay occurring in the acceptance and transit of this traffic. A similar communication was addressed to the railway companies by the Committee at the beginning of the year.

A large proportion of the complaints received related to consignments of basic slag, but there are, of course, special difficulties

as regards this material, which is generally produced in districts where large quantities of munitions are now being manufactured.

In connection with complaints as to delays in delivery of agricultural feeding-stuffs the Board ascertained that precedence next to Government traffic is, generally speaking, given to feeding-stuffs for stock.

Towards the end of February complaints were received as to delays in the carriage of agricultural seeds, and, at the instance of the Board, the Railway Executive Committee requested railway companies to give special facilities for the handling of this traffic.

Similar action was taken in May with reference to the transport of agricultural machines, and the railway companies were asked to pay special attention to this traffic also.

Conveyance of Fruit and Returned Fruit Empties.—Comparatively few complaints were received respecting the transport of the strawberry crop. The railway companies were, apparently, able to make arrangements to cope with the demands of this traffic. More difficulty was experienced in regard to the very heavy plum traffic and the railway companies were approached by the Board in certain instances of delay.

In the case of apples and pears it was deemed advisable to warn growers that in order to avoid possible inconvenience it would probably be well to store part of the crop, as it might not be possible to secure conveyance of the fruit, as picked, by rail.

Complaints of delay in the transit of fruit empties were numerous, and difficulties were enhanced by the shortage of carting facilities. The Board are in communication with the railway company principally concerned as to the steps which might be taken by those concerned to minimise these delays.

Fertilisers and Feeding Stuffs Act, 1906.—During the year communications were received from local authorities in England and Wales as to 40 cases of alleged contravention of the Act, and in 18 of these the Board issued consent to the institution of proceedings. In 9 cases fines were imposed and in 3 the proceedings were dismissed. In the remaining instances no proceedings were, for various reasons, taken by the local authorities concerned.

The number of communications received from local authorities on this subject in 1914 was 37, and the number of cases in which consent was issued was 23.

The total number of samples taken under the Act in 1915 was 3,462, of which 628 were unsatisfactory, as compared with 3,857 taken in 1914, of which 610 were unsatisfactory. In England 951 samples of fertilisers were taken, compared with 1,164 in

1914, and in Wales 131, compared with 174 in 1914. The numbers of samples of feeding-stuffs taken in England were 2,025 in 1915, against 2,091 in 1914, and in Wales 355, against 428 in 1914.

Sale of Food and Drugs Acts, 1875-1907.—As in previous years complaints were received indicating that the administration of the above Acts in relation to milk in some respects, and in certain districts, resulted in hardship to the seller of milk which, though containing less than the proportion of fat or solids-not-fat referred to in the Sale of Milk Regulations was, nevertheless, genuine. The position was again considered and, after consultation with the Local Government Board, a circular letter was issued to local authorities suggesting that before proceedings are instituted there should be a preliminary investigation into the circumstances, or that the producer should be given an opportunity of making any report or explanation he may wish. A copy of this circular letter was published in this *Journal* for December, 1915.

The numbers of factories registered under the above Acts in England and Wales at the end of the year were:—Butter factories, 233; milk and butter mixture factories, 7; margarine factories, 27; and margarine cheese factories, 5. The inspection of these factories has been continued so far as circumstances have permitted.

Merchandise Marks Acts, 1887-1894.—Various cases of suspected contravention of the Merchandise Marks Act, 1887, in respect of agricultural produce, came under notice during the year and were investigated by the Board's Inspectors.

Nine prosecutions were instituted for the misdescription of imported meat as English or Scottish, and five for the misdescription of imported tomatoes as English. Proceedings were also instituted in a case in which imported honey was described as Cambridgeshire. Fines were inflicted in all cases.

IN an appeal to the farmers and occupiers of land in England and Wales, issued in September, 1915, Lord Selborne said:—

"As Minister of Agriculture in this How to Increase the "present time of War, I desire to appeal to Production of Food "you who live by the land to assist your During the War.* "King and Country by producing as much "food as possible on your holdings in the "coming year. It is always a wise precaution for a nation at

* This article is a reprint of Special Leaflet N. 55, which was drafted by a special committee of the Welsh Agricultural Council in conjunction with the Agricultural Commissioner for Wales, and the Board desire to give it the widest possible publicity in the Principality.

The Leaflet is especially intended for distribution in Wales, and copies will not be sent to subscribers to the JOURNAL without special application.

"war to provide as much food as it can within its own borders. "You must remember that this war has to be fought with money "as well as men, and every additional pound's worth of food "which you can grow means a reduction in the quantity to be "purchased from abroad, and is, therefore, a direct contribution "to victory.

* * * * *

"I ask you for your part to devote all your energies to the "task that is set before you, and I am confident that I shall "not ask in vain."

The Welsh Agricultural Council at a meeting held in December last recommended the Board of Agriculture and Fisheries to issue a special leaflet containing suggestions as to how Welsh farmers might assist in increasing the production of food during the war, and this recommendation was approved by the Board.

The Council now desire to draw the attention of Welsh farmers to the following suggestions:—

(1.) **More Attention should be Paid to the Care of Grass Land.**—Experience has shown that much comparatively inferior grazing land can be greatly improved by dressings of basic slag, from 6-10 cwt. per acre being recommended. The Council have no hesitation in recommending very strongly that farmers should greatly increase their use of this manure.

The removal of surplus herbage by thorough grazing or other means, before the slag is applied, is of great importance. In cases where the fields are covered with a thick mat of bent grass, an effort should be made to drag out the bent with a toothed harrow or some other tined implement before the manure is applied. Deterioration has often been proved to be due to the practice of taking hay repeatedly year after year, especially when the hay is cut too late in the season, this practice leading to great excess of Yellow Rattle, Yorkshire Fog and other weeds.

(2.) **Artificial Manures should be more Extensively Used.**—Of an area of about 2,977,000 acres of arable and grass land (excluding mountain and heath) in Wales, little more than about 343,000 acres are under oats, wheat and barley. Even if the area under grain crops is not extended the yield per acre could be substantially increased by the more general application of artificial manures. Dressings of from $\frac{1}{2}$ cwt. to 1 cwt. of sulphate of ammonia, and 1 to 2 cwt. of superphosphate or 2 to 3 cwt. of basic slag per acre have been found very profitable. Dressings similar in character, but slightly more liberal than these, may be recommended for corn when taken after another corn

crop. Artificial manures are equally effective when applied to potatoes, roots, hay and forage crops. In Wales it is of special importance that all land under hay should be liberally manured.

Certain leaflets issued by the Board, a list of which can be obtained on application, give detailed information and directions relating to this matter. Farmers may also receive advice on matters relating to manures and soils from the Adviser in Agricultural Chemistry, University College of Wales, Aberystwyth (for the Aberystwyth area), and the Adviser in Agricultural Chemistry, University College of North Wales, Bangor (for the Bangor area), either directly or through the County Agricultural Organisers.

In connection with manuring, efforts should also be made to prevent waste of liquid manure or of any of the farmyard manure produced at home. Near the coast all the seaweed available should be used as manure. The attention of farmers is also drawn to the need of lime on much of the land in Wales. Farmers are urged to consider the advantages of co-operation in the purchase of manures as well as of feeding-stuffs.

(3.) **New Varieties and Change of Seed.**—Farmers are strongly urged to use new and improved varieties of oats, potatoes, etc., experience having shown that the produce of the land may be very largely increased in this way. It is also suggested by the Council that farmers should consider the advisability of change of seed in connection with cereals, and, particularly, potatoes. The benefit in the case of cereals which follows a change of seed from an early to a less early district is, independently of change of variety, often substantial. In the case of potatoes, efforts might be made to procure Scotch "seed." Irish seed potatoes, if well selected, also frequently do well in Wales.

(4.) **Grass and Clover Seeds.**—More attention should be paid to the purchase of grass and clover seeds. The rye grasses, cocksfoot, red clover, and Dutch clover commonly bought are frequently very unreliable. The rye grasses and cocksfoot so largely employed are often of poor bushel weight. Italian rye grass frequently contains from 10 to 30 per cent. of perennial rye grass, which would give to an inferior sample a quite fictitious bushel weight. Much of the red clover on the market is of South American origin, and this does not succeed so well in Wales as samples of British growth. Cheap samples of white or Dutch clover are often almost worthless, and consist largely of trefoil, suckling clover and weeds. Reliable samples cannot be purchased under 1s. 9d. to 2s. per lb. For further particulars on the subject see others of the Board's leaflets.

Seeds can be tested for farmers in the Aberystwyth College area by the Adviser in Agricultural Botany, University College of Wales, Aberystwyth, and in the Bangor College area by the Adviser in Agricultural Botany, University College of North Wales, Bangor. Arrangements have also been made by the Glamorganshire Education Committee by which farmers resident in that county may have their seeds tested at the University College, Cardiff.

(5.) **Wherever possible Catch Crops should be Crown.**—A catch crop is a crop taken between two ordinary crops in a rotation. Mustard, vetches, rye, rape, etc., can be successfully grown as catch crops in many parts of Wales. Where these or other catch crops are grown, they add materially to the stock-keeping capacity of the farm.

(6.) **Leguminous Crops and Linseed.**—Whether as catch crops or otherwise, every effort should be made to extend the cultivation of leguminous crops, as these answer the double purpose of supplying valuable produce and enriching the soil.

The practice which was once common on many Welsh farms of growing linseed for home use should be revived, as it is one much to be recommended under present circumstances.

(7.) **More and Better Quality Stock should be Reared.**—The advice that more stock of better quality should be reared does not necessarily mean less cultivation.

Wherever possible, advantage should be taken of the Board's Live Stock Improvement Scheme. In the case of horses, no sire should be used that does not hold a certificate of soundness from the Board of Agriculture and Fisheries for the year in which it is proposed to use him.

The Council recommend that pigs should be more generally kept. It is perhaps not sufficiently realised that there is a quicker and more profitable return on capital to be had from pigs than from any other class of farm stock, except perhaps poultry. In this connection the Board's Special Leaflet No. 30 (*The Use of Forage Crops for Pig Feeding*) may usefully be consulted.

(8.) **Efforts should be made to Increase the Production of Cheese.**—Cheese has special value as a food, and the Council are of opinion that there are many districts in Wales where more cheese might be made with advantage (see Special Leaflet No. 41, *The Importance of Producing more Cheese*). Special arrangements have been made by the Board for giving assistance to local authorities in connection with the formation of local cheese-making classes. Farmers may receive information as to these through the County Officers.

(9.) **Poultry-keeping should be Extended.** — There is here a source of food supply that can be largely increased without interfering to any extent with the normal stock-carrying capacity of the farm. Not only might the numbers of poultry kept be increased very considerably, but by keeping well-selected birds the egg production can be enormously developed. When it is stated that by selection of a good breed, and good strains of that breed, the number of eggs per hen can be increased probably 100 per cent., and that without increasing the cost of feeding, it is evident that there is great room for improvement.

The Board have recently established a scheme for the development of poultry production in Wales, including the provision of incubating stations for North Wales, and egg-distributing stations for each county in Wales. Day-old chickens from pure strains will be sold from the following incubating stations to residents in Denbigh, Flint, Anglesey and Carnarvon, at a price not exceeding 4s. a dozen, carriage forward. Communications in reference to this part of the scheme should be addressed as follows :—

Anglesey	..	..	Miss M. Stanton, Lledwigan, Llangeini
Carnarvon	..	..	Mr. John Rowlands, Madryn Castle Farm School, Pwllheli.
Denbigh and Flint	..	..	Miss M. Black, Lleweni Hall Dairy School, Denbigh.

Sittings of 12 eggs from pure-bred hens will be sold, from the 1st December to the 30th April in each year, by each station holder to cottagers and small holders resident in the county at 2s. per doz. including the provision of a suitable box for packing, carriage to be paid by the purchaser. Infertile eggs (if returned, carriage paid) will be replaced. A list of the egg distributing stations in each county, with forms of application for sittings, may be obtained from the County Officers shown in List I.*

While the Board will be glad to give assistance in connection with any of the matters referred to in this leaflet if they are communicated with directly or through the Agricultural Commissioner for Wales (at his office at 30, Pier Street, Aberystwyth), farmers are strongly urged to make use of the facilities provided by the Colleges and Agricultural Institutions for giving expert assistance and advice. Communications should be sent either direct, or through the County Officer shown in List I,* to the Professor of Agriculture, University College of Wales, Aberystwyth (for the counties of Brecon, Cardigan, Carmarthen,

* Not here printed.

Glamorgan, Monmouth, Merioneth, Montgomery, Pembroke and Radnor), and to the Professor of Agriculture, University College of North Wales, Bangor (for the counties of Anglesey, Carnarvon, Denbigh and Flint). Communications relating specifically to seeds, manures and soils may be sent direct to the Advisers in these subjects as indicated above.

Farmers in the counties of Carnarvon and Monmouth should also take advantage of the services of the staffs of the Madryn Castle Farm School, Pwllheli, and of the Monmouthshire Agricultural Institution at Usk. Communications should be addressed to the Principal in each case.

Communications with respect to the improvement of live stock (horses, cattle and pigs) should be addressed to the Live Stock Officer, University College of Wales, Aberystwyth (for the counties of Brecon, Cardigan, Carmarthen, Glamorgan, Monmouth, Pembroke and Radnor), and to the Live Stock Officer, University College of North Wales, Bangor (for the counties of Anglesey, Carnarvon, Denbigh, Flint, Merioneth and Montgomery).

A War Agricultural Committee has been established in each county in Wales for the purpose of assisting farmers in connection with any problems or difficulties which may confront them in their efforts to maintain or increase the production of food during the war. Difficulties encountered in the purchase of seeds and manures, or in the sale of produce, or with regard to the supply of labour, should be at once communicated to the Secretary of the War Agricultural Committee for the County (See List II.).*

Farmers can play no more patriotic part in the present national crisis than by doing their utmost to increase the home production of food. By so doing they diminish the demand for foreign produce, and thereby help to conserve the resources of the nation.

Some of the suggestions made in this Leaflet have been taken from Leaflet No. 31, issued by the Board of Agriculture for Scotland.

IN view of the importance of using every effort to grow heavy crops during the war, it is hoped that farmers, in their own interests and in those of the nation

The Use of Sulphate of Ammonia as Manure. generally, will avail themselves without delay of the present opportunity of obtaining ample supplies of sulphate of ammonia for spring use. The following figures, based

* Not here printed.

on the Board's Returns for the London Market, show that sulphate of ammonia, in common with other manures, has advanced considerably in price since the outbreak of war:—

	Feb., 1914.	Feb., 1916.	In- crease per cent.
Price per unit of nitrogen in sulphate of ammonia	13 2	17 0 [*]	29
" " nitrate of soda ..	14 10	21 9 [‡]	47
" " soluble phosphate in superphosphate ..	1 9	2 10	62
" " insoluble phosphate in basic slag ..	1 6	1 9 [‡]	19
" " insoluble phosphate in bone meal ..	1 7 [‡]	1 10 [‡]	15
" " <i>allowed for nitrogen</i> ..	15 7	18 8	20
" " insoluble phosphate in steamed bone flour ..	1 4	1 11 [‡]	47
" " <i>allowed for nitrogen</i> ..	12 9	19 4	52

Against the 29 per cent. rise in the price of sulphate of ammonia must be set the proportionately greater increase in the value of the principal farm crops.

In the following statement, based on recent field experiments, an attempt is made to show the average increase in the various crops, and the value of such increase, that may be expected from the use under suitable conditions, of 1 cwt. of sulphate of ammonia per acre. The crops have been valued at prices considerably under those now ruling in the London and other markets:—

	£ s. d.	£ s. d.
Wheat, 4½ bush. @ 55s. per qr. ..	1 11 0 [‡]	2 1 0
" straw, 5 cwt. @ 40s. per ton ..	10 0	2 9 11
Barley, 6½ bush. @ 50s. per qr. ..	2 0 7 [‡]	2 9 11
" straw, 6½ cwt. @ 30s. per ton ..	9 4 [‡]	1 18 3
Oats, 7 bush. @ 30s. per qr. ..	1 6 3 [‡]	1 18 3
" straw, 6 cwt. @ 40s. per ton ..	12 0 [‡]	2 10 0
Rye-grass hay, 10 cwt. @ 100s. per ton ..	..	1 16 0
Meadow hay, 8 cwt. @ 90s. per ton ..	..	1 0 0
Mangolds, 32 cwt. @ 12s. 6d. per ton ..	..	3 0 0
Potatoes, 20 cwt. @ 60s. per ton ..	..	3 0 0

Consideration of the foregoing figures shows that there is ample justification for the liberal use of reliable manures at the present time.

* Average of Hull, Newcastle and Newport Markets.

† " Hull, Liverpool, Widnes and Bristol Markets.

‡ " Hull and Newcastle Markets.

Of the two chief classes of manures, nitrogenous and phosphatic, the former are usually the more effective in increasing the yield of the crop. Where nitrogen is given freely, whether in the form of dung or an artificial fertiliser, it is desirable, however, to effect a proper "balance" by applying a dressing of superphosphate (or, in some cases, basic slag, bone meal or mineral phosphate). This prevents undue rankness, hastens maturity, and improves the quality of the produce.

In certain districts it may be possible to obtain nitrogen in the form of nitrate of lime or calcium cyanamide at a somewhat cheaper rate than in the form of sulphate of ammonia, but, for general purposes, the last-named fertiliser will usually be the most suitable and its use is recommended.

To obtain the best results with sulphate of ammonia it should be incorporated with the soil as far as conditions will allow.

The following are examples of manurial dressings (per acre) suitable, in average circumstances, for the crops mentioned:—

Wheat.—1 to $1\frac{1}{2}$ cwt. of sulphate of ammonia, applied before harrowing the wheat in spring.

Barley.— $\frac{3}{4}$ to 1 cwt. of sulphate of ammonia and 2 cwt. of superphosphate, applied at seed time and harrowed in.

Oats.—1 to $1\frac{1}{4}$ cwt. of sulphate of ammonia, and 2 cwt. of superphosphate applied at seed time and harrowed in.

Hay (Rye-grass and Clover).—1 cwt. of sulphate of ammonia and 3 cwt. of superphosphate applied in March. If clover predominates in the mixture, sulphate of ammonia should be reduced to $\frac{1}{2}$ cwt.

Hay (Meadow).— $1\frac{1}{2}$ cwt. of sulphate of ammonia and 3 cwt. of superphosphate applied in March.

Pasture, Beans, Peas, Lucerne, Sainfoin, Vetch Mixture.— $\frac{1}{2}$ cwt. of sulphate of ammonia and 5 cwt. of superphosphate.

Mangolds.—

With Dung.—1 cwt. of sulphate of ammonia, 4 cwt. of superphosphate, 4 cwt. of salt, applied in the drills; 1 cwt. of sulphate of ammonia or nitrate of soda applied after thinning.

Without Dung.— $1\frac{1}{2}$ cwt. of sulphate of ammonia, 6 cwt. of superphosphate, 4 cwt. of salt, applied before the seed is sown; 1 cwt. of sulphate of ammonia or nitrate of soda applied after thinning.

Swedes, Turnips, Kale, Rape.—

With Dung.— $\frac{1}{2}$ to 1 cwt. of sulphate of ammonia and 4 cwt. of superphosphate applied in the drills.

Without Dung.—1 to $1\frac{1}{2}$ cwt. of sulphate of ammonia and 6 cwt. of superphosphate applied before the seed is sown.

Potatoes.—

With Dung.—1 cwt. of sulphate of ammonia and 4 cwt. of superphosphate applied in the drills.

Without Dung.—(After ley) 2 cwt. of sulphate of ammonia and 5 cwt. of superphosphate applied in the drills.

Phosphatic Manures for Use along with Sulphate of Ammonia.—In purchasing superphosphate preference should be given to the cheapest form, per unit of soluble phosphate, usually the 35 per cent. quality. Three cwt. of superphosphate 35 per cent. contains the same amount of soluble phosphate as 4 cwt. of superphosphate 26 per cent., and by using the former a saving is effected in respect of both carriage and handling. Superphosphate is, generally, the best form of phosphatic manure for all arable crops, and it may be mixed with sulphate of ammonia before application. Basic slag (which must not be mixed with sulphate of ammonia) may be substituted for superphosphate in a district of ample rainfall and when the land is deficient in lime and rich in organic matter; otherwise it should be preferred only when the price per unit of citric soluble phosphate is considerably lower than the corresponding price of water soluble phosphate in superphosphate. (At the time of writing the cost, at London, of one unit of citric soluble phosphate in basic slag is 2s. $7\frac{1}{2}$ d. as compared with 2s. $8\frac{1}{2}$ d. for one unit of water soluble phosphate in superphosphate, 35 per cent., and the latter is to be preferred except for soils deficient in lime.)

Where difficulty is experienced in obtaining a sufficient supply of either superphosphate or basic slag, a mixture of superphosphate and a finely-ground soft mineral phosphate may be employed instead; no more mineral phosphate being used, for general purposes, than is absolutely necessary. For grass and turnip land, rich in organic matter and situated in a rainy district, a dressing of ground mineral phosphate may take the place of either superphosphate or basic slag.

Another method of supplementing the supply of superphosphate is to mix it with bone meal or steamed bone flour, whichever is cheaper. (The unit price, in London, of insoluble phosphate at the present time is 1s. 11d. in bone meal, 1s. $11\frac{1}{2}$ d. in steamed bone flour and 1s. 6d. in raw mineral phosphate).

The current unit prices and notes on the uses of manures are published monthly in the Board's *Journal* (see pp. 1281-5). The subject of manures and manuring is dealt with in some detail in several of the Board's leaflets, copies of which may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

Of the chief food ingredients required by plants only three, viz., nitrogen, phosphates and potash, have to be applied directly in the form of manure. Farmyard manure **The Manuring of** contains all three, but artificial fertilisers **Cottage Gardens and** usually contain only one or two of the **Allotments.*** necessary ingredients.

A fourth substance, lime, is required, not so much as a plant food as on account of its action on the soil.

For information as to the principles of manuring and the properties of the different fertilisers, readers are referred to the Board's Leaflet No. 72 (*The Purchase of Artificial Manures*).

Farmyard Manure.—The manure at the disposal of the cottager and allotment holder is often poor in quality, as compared with farmyard manure made in well-constructed cattle-feeding yards. It is apt to contain too much straw, or other litter, and too little of the animal excreta. In view of the bulk of material applied, therefore, the crop returns obtained from its application are often disappointing.

When the manure has to lie for some time in a heap before application it should be covered with about 6 in. of soil in order to preserve the fertilising material.

In the case of heavy soils the manure is best dug in during autumn and winter; in the case of light soils this should be done in spring, some time before cropping.

The undecayed portions of the manure should preferably be used for the green crops (cabbage family), the more completely decayed portions for the root, fruit and flower crops.

An average market-garden dressing of manure would be about $2\frac{1}{2}$ -3 cwt. per rod ($30\frac{1}{4}$ sq. yd.). A large barrow-load of moderately decayed manure will usually weigh about 1 cwt.

Where the full dressing of ordinary manure cannot be obtained, artificial manures, as indicated below, may be applied with advantage.

Potatoes.—Where the crop is grown on the flat, sulphate of ammonia should be applied on the surface just before the first earthing up, at the rate of $\frac{1}{2}$ oz. per sq. yd. (1 lb. per rod, or $1\frac{1}{2}$ cwt. per acre). Where potatoes are planted in drills the sulphate of ammonia may be applied in the drills at the time of planting.

Superphosphate of lime should be applied at the rate of $1\frac{1}{2}$ oz. per sq. yd. (3 lb. per rod, or $4\frac{1}{4}$ cwt. per acre), and may be forked in lightly before planting on the flat, or applied in the drill at the time of planting; or, superphosphate and steamed

* This article is a Reprint of Special Leaflet No. 56, just issued, copies of which will not be sent to subscribers to the *Journal* without special application.

bone flour may be mixed in equal proportions and applied when planting at the same rate as in the case of superphosphate alone.

Cabbage Family.—All the members of this group respond to applications of nitrogenous manures.

Sulphate of ammonia should be applied at the rate of $\frac{1}{2}$ - $\frac{3}{4}$ oz. per sq. yd. (1- $\frac{1}{2}$ lb. per rod, or $1\frac{1}{2}$ -2 cwt. per acre) before the first earthing up, or as soon as growth starts.

Where cabbage crops are slow in "hearting," and turnip crops refuse to "bulb," phosphates are usually deficient.

Superphosphate should be applied, alone or in combination with steamed bone flour, at the rate of 1 oz. per sq. yd. (2 lb. per rod, or 3 cwt. per acre) at the time of planting, or before the first earthing up.

In inland districts, where allotment crops on light and medium soils are liable to suffer from drought, salt is very helpful and will usually increase the crop. It should be applied at the rate of 1 oz. per sq. yd.

Pea and Bean Family.—Crops belonging to the pea and bean family can usually provide themselves with sufficient nitrogen.

A mixture of superphosphate and steamed bone flour, in equal proportions, should be applied to the ground before or after sowing the seed at the rate of 1 oz. to 4 yd. in length of drill.

The manure should never be sown in the bottom of the drill so as to come in direct contact with the seed.

Onions, Leeks and Celery.—Sulphate of ammonia should be applied at the rate of $\frac{1}{2}$ oz. per sq. yd. (1 lb. per rod, or $1\frac{1}{2}$ cwt. per acre), with superphosphate and steamed bone flour, mixed in equal proportions, at the rate of 1 oz. per sq. yd. On light soils, liable to dry out, salt may be given with advantage (1 oz. per sq. yd.). These crops should all be manured in the early stages of growth.

Carrots, Parsnips and Beets.—Sulphate of ammonia should be applied at the rate of $\frac{1}{2}$ oz. per sq. yd. after singling. Superphosphate and steamed bone flour, mixed, at the rate of 1 oz. per sq. yd., should be applied before sowing the seed. On dry soils, 1 oz. of salt per sq. yd. may be applied before drilling.

Lettuce, Spinach and Radishes.—These are greatly helped by applications of sulphate of ammonia, which should be applied at the rate of $\frac{1}{2}$ oz. per sq. yd., in the early stages of growth. Where radishes do not "bulb" readily, superphosphate, at the rate of 1 oz. per sq. yd. should be applied to the soil before sowing.

Where the soil is known to be overstocked with organic matter (containing nitrogen), producing a very rank growth of leaf, the

sulphate of ammonia should be withheld. This reservation applies to all the crops dealt with in this article.

Liquid Manure for Fruit and Flower Crops.—One peck of poultry manure or 1 peck of sheep droppings placed in a 40-gal. cask and filled up with water will, after standing 2½ hours, make an excellent liquid manure if applied while fruit is swelling and, in the case of flowers, while the blooms are opening: 2 gal. per sq yd. should be applied weekly.

Where the above materials cannot be obtained, ¾ lb. sulphate of ammonia and 1 lb. superphosphate in 30 gal. of water will make a safe liquid manure, which may be applied at the rate of 2 gal. per sq. yd.

General Considerations.—The recommendations made above are drawn up to meet the conditions now existing with regard to the supply of chemical manures. Potash salts are hardly obtainable, but wood ashes, which contain potash, should be collected and applied at the rate of 1 oz. per sq. yd. to soil in which potatoes, peas, beans, carrots, parsnips and onions are to be grown. The richest ash is produced by hedge clippings, prunings of fruit bushes, nettles and coarse-growing weeds burnt before they are fully ripened. The ash of timber may contain little potash. Ash must be collected as soon as possible after burning, as rain quickly washes out the potash.

Recent experiments tend to show that members of the cabbage family can avail themselves of the stores of potash already in the soil to a greater extent than most other crops, and this circumstance should be borne in mind while potash is scarce.

On heavy soils, and soils rich in organic matter, basic slag may replace superphosphate, particularly in districts with a good rainfall. The quantity used should be from one and a half times to twice as much as is recommended in the case of superphosphate.

The present prices of the manures referred to in this article are about as follows, when bought in quantities of 1 ton or more:—

		Per ton.
		<i>f. s. d.</i>
Sulphate of Ammonia	20 per cent. of Nitrogen ..	17 0 0
Superphosphate ..	35 per cent. of Soluble	5 0 0
	Phosphates.	
Steamed Bone Flour	1 per cent. Nitrogen and 60 per cent. Insoluble	7 0 0
	Phosphates.	
Basic Slag ..	20-30 per cent. of total	1 14 0
	Phosphates	to 2 10 0
Agricultural Salt ..	.. .. ..	1 12 0

Allotment holders should order their manures co-operatively so as to save on the carriage and secure the advantage of the lower prices at which dealers are prepared to quote for considerable quantities.

The prices charged for small quantities of 1 cwt. or less vary very much with the district and the cost of carriage from the nearest manure works.

Autumn Wheat.—Land which has received 10 loads or more of dung per acre for wheat seldom receives further manuring in spring, nor, in the case of land in good

The Manuring of Corn in the Spring of 1916.* condition would manure be used after a root crop or a good clover root. The present need, however, for producing as much wheat as possible is so important that, even in such cases as those mentioned, the young crop should be closely watched and prompt aid given if necessary. In the case of most crops (including crops on poor land dressed with sulphate of ammonia in the late autumn) the farmer should make up his mind that a top-dressing is desirable this year; for, in view of the probable price of wheat, there is every likelihood that suitable dressings of artificial manures will be unusually profitable.

The most important manurial element for wheat is nitrogen, which as a rule this year will be best applied in the form of sulphate of ammonia. From 1 to $1\frac{1}{2}$ cwt. per acre, according to circumstances, should be given as soon as the risk of severe frost is past. If more than 1 cwt. is applied, it is desirable to give the manure in two dressings at an interval of not less than a fortnight. The later dressing should usually be applied before the beginning of April in the Eastern Counties and South of England. If sulphate of ammonia is skilfully used, as much as $1\frac{3}{4}$ cwt. per acre may be profitably used in spring. With a view to hastening maturity, and improving the quality of straw and grain, about 2 cwt. per acre of superphosphate might be applied any time in March to land needing phosphates.

Spring Wheat.—Unless the soil is highly fertile it will, as a rule, be desirable to apply some artificial manure for spring wheat, with the two-fold object of encouraging growth and hastening maturity. A dressing of 1 cwt. to $1\frac{1}{4}$ cwt. of sulphate of ammonia and, on poor land, 2 to 3 cwt. of superphosphate per acre, will usually suffice. The manure should be applied before the final

* Reprint of the revised edition of Special Leaflet No. 23, copies of which can be obtained free on application.

harrowing, or superphosphate alone may be applied at that time and 1 cwt. to $1\frac{1}{2}$ cwt. of sulphate of ammonia may be top-dressed in the first half of April. If the spring is wet, and the young wheat is yellow and backward towards the middle of April, a nitrogenous manure will certainly prove useful.

Barley.—After mangolds or other roots which have been liberally manured with dung and artificials, or after turnips which have been folded, further manuring will usually be unnecessary. After a white straw crop, or if in any circumstances manuring is considered desirable, $\frac{3}{4}$ cwt. to 1 cwt. of sulphate of ammonia and 3 cwt. of superphosphate per acre should be well mixed and harrowed into the land at seed time.

Where barley is liable to lodge, the nitrogenous manure should be reduced to half the quantity or be omitted.

Oats.—In the later districts where the growing of spring wheat would be attended with risk, and in all districts known to grow oats satisfactorily, farmers would be well advised to devote particular attention to securing a heavy crop this year. After pasture of good quality no manure may be necessary, but after most other crops, it will probably pay well to apply manure unless the land is in a high state of fertility. In most climates $\frac{3}{4}$ to 1 cwt. of sulphate of ammonia either alone or mixed with 2 cwt. of superphosphate and applied at seed time, should give satisfactory results. In late-ripening districts, or on deep, productive land, a smaller quantity of sulphate of ammonia should be used. On light land, particularly in the drier districts, or if in any circumstances it seems necessary to help a weak plant, a top dressing of 1 to $1\frac{1}{4}$ cwt. per acre of nitrate of soda may take the place of sulphate of ammonia. The application of nitrate of soda should not be too long delayed after the plant is up, or ripening will be retarded. It should usually be applied when the crop is 3 to 4 in. high.

Straw.—In addition to increasing the supply of home-grown grain, the use of suitable manures provides the farmer with more straw. The importance of this under present conditions can hardly be over-estimated. A bulky straw crop helps to suppress weeds, and thus saves labour in connection with future crops. Straw is a valuable substitute for hay, which at present is being largely sold off the farm, and it is the best means at the farmer's disposal of increasing and conserving the manure heap. In the event of a shortage of roots, straw "chaff" is practically indispensable. For fodder purposes, oat straw is undoubtedly the stiffest. In this connection it is worthy of note that the stiff-

strawed varieties, which stand manuring best, can be improved in palatability by fairly thick sowing without serious risk of "lodging." To the same end, a stout-strawed variety is sometimes sown in mixture with one of the finer-strawed kinds. Further information on this subject is contained in Special Leaflet No. 47 (*The Use of Straw for Fodder*).

Prices.—On account of the wide variation in prices of the same article of food at different markets it has been found

necessary again this month to compile lists

Notes on Feeding Stuffs in March: of prices per food unit for each separate

From the Animal Nutrition Institute, Cambridge University. market. The tables are, therefore, set out

on exactly the same plan as last month. On the whole, prices per food unit are within a penny of the prices of last month,

the majority of foods showing a reduction. Maize, maize meal and Burmese rice meal have risen in price and English oats have remained at their former level; otherwise, starchy foods have fallen by from $\frac{1}{2}d.$ per food unit in the case of Argentine oats to $2\frac{1}{2}d.$ in the case of wheat pollards. Notable advances in cost per food unit are Egyptian rice meal ($5\frac{1}{4}d.$), Burmese rice meal ($3d.$), malt culms ($2\frac{1}{2}d.$), English dun peas ($2d.$), and Argentine maize ($1\frac{1}{4}d.$). Chinese beans are cheaper by $2\frac{1}{2}d.$, English maple peas by $1\frac{1}{4}d.$, and Egyptian cotton seed by $1\frac{1}{4}d.$.

Thanks are due to Professor R. G. White, University College of North Wales, Bangor, and Mr. G. H. Garrad, Wye College, for information as to the use of palm-nut kernel cake for sheep. In their hands this feeding-stuff has proved a safe and useful food for fattening sheep. Several other correspondents have been good enough to send information on various points.

Suggested Rations for March.—For Horses.—The difficulty mentioned last month of working out a cheap and satisfactory ration to replace oats for horses, on account of the high price of all starchy foods, is accentuated this month by the rise in price of rice meal. The following mixture is suggested:—

Dried brewers' grains	4 lb.
Bran, pollards, sharps or middlings, whichever is cheapest	4 "
Linseed cake	2 "
Crushed beans	1 "

This mixture is richer than oats in protein, and has rather a higher feeding value. Eleven pounds of it should be used to

replace 12 lb. of oats. The proportion of straw chaff may also be increased, and the diet will be improved by the addition of a few mangolds.

TABLE I.

Feeding Stuff.	Units	Approximate prices per ton at the end of February.			
		London		Liverpool	
		£	s.	£	s.
Soya Bean Cake ..	122 ³	11	16	3	12 5 0
Decorticated Cotton Cake	126 ³	12	16	3	13 5 0
Indian Linseed Cake ..	123 ¹	12	13	9	13 5 0
English Linseed Cake ..	120 ¹	13	2	6	13 15 0
Bombay Cotton Cake ..	65 ³	—	—	10	7 6
Egyptian Cotton Cake ..	71 ⁹	10	0	0	10 10 0
Coconut Cake ..	102 ⁶	10	12	6	10 15 0
Palm-nut Kernel Cake ..	90 ⁵	9	10	0	9 5 0
Ground-nut Cake ..	145 ²	12	0	0	11 0 0
English Beans ..	99 ⁵	11	17	7 ¹	14 0 0
Chinese Beans ..	101 ²	9	11	4	12 2 8
English Maple Peas ..	97 ²	14	4	5	—
English Dun Peas ..	97 ²	12	13	4	—
Calcutta White Peas ..	97 ⁵	17	2	3	—
American Maize ..	93 ⁸	13	1	4	12 12 0
Argentine Maize ..	94 ²	12	2	8	12 10 2
Maize Meal ..	86 ⁵	13	0	0	13 12 0
Maize Gluten Feed ..	121 ⁶	11	0	0	—
Maize Germ Meal ..	99 ²	12	0	0	13 6 0
English Feeding Barley ..	83 ⁰	—	—	—	15 2 5
English Oats ..	75 ⁴	12	0	0	12 8 11
Argentine Oats ..	75 ⁴	11	19	6	12 0 7
Malt Culms ..	69 ⁹	8	12	6	9 0 0
Brewers' Grains (dried) ..	82 ⁵	8	0	0	—
" (wet) ..	211 ⁸	1	7	0	—
Egyptian Rice Meal ..	78 ⁷	13	0	0	—
Burmese Rice Meal ..	78 ⁷	12	0	0	10 10 0
Wheat middlings ..	93 ⁴	10	2	6	—
Wheat Sharps ..	80 ³	10	5	0	10 10 0
Wheat Pollards ..	81 ⁹	—	—	9	7 6
Wheat Bran ..	77 ⁵	9	10	0	9 5 0
Wheat Bran (broad) ..	79 ⁹	10	5	0	10 0 0
Feeding Treacle ..	60 ⁰	9	18	9	10 15 0
Linseed ..	153 ⁵	20	17	4	26 0 0
" Oil ..	250 ⁰	45	0	0	48 0 0
Egyptian Cotton Seed ..	108 ⁶	14	0	0	—
Brazilian ..	107 ⁰	—	—	—	—
Cotton Seed Oil ..	250 ⁰	—	—	55	0 0

* 2nd grade, £10 5s.

† " " £11 10s.

‡ Porter grains (London), £8 15s.

§ Porter grains (London), £1 15s.

For Milch Cows.—The rations suggested last month may be continued, but Ration II. may be made cheaper by the substitution of tail corn for rice meal. The cheapest ration for milch cows which has come under notice is a very large allowance of

roots—mangolds—with usual quantities of hay and straw, and no concentrated food except ground-nut cake.

The following ration has been worked out on these lines for a cow of 10 cwt. live-weight, giving 2 gal. of milk per day:—Mangolds, 8*1* lb.; hay, 10 lb.; straw, 10 lb.; and ground-nut cake, 2 lb. For each extra gal. of milk per day above 2 gal. the diet should be increased by 1*1*₂ lb. of ground-nut cake, but the whole amount of ground-nut cake should not exceed about 4 to 5 lb. per head per day. If the milk yield exceeds 3 gal. the allowance per extra gal. should be 1 lb. of ground-nut cake, 1 lb. of dried grains, bran or other food of that kind.

TABLE II.
PRICES PER FOOD UNIT. LONDON.

	s. d.		s. d.
Brewers' grains (wet) ..	1 3 <i>1</i>	Wheat bran (broad) ..	2 6 <i>3</i>
Ground-nut cake ..	1 7 <i>3</i>	Argentine maize ..	2 7
Maize gluten feed ..	1 9 <i>3</i>	Egyptian cotton seed ..	2 7
Chinese beans ..	1 10 <i>3</i>	English dun peas ..	2 7 <i>1</i>
Soya bean cake ..	1 11 <i>1</i>	Linseed ..	2 8 <i>3</i>
Decorticated cotton cake ..	2 0 <i>1</i>	Egyptian cotton cake ..	2 9 <i>1</i>
Coconut cake ..	2 0 <i>2</i>	American maize ..	2 9 <i>1</i>
Indian linseed cake ..	2 0 <i>3</i>	English maple peas ..	2 11
Palm-nut kernel cake ..	2 1 <i>1</i>	Maize meal ..	3 0
Brewers' grains (dried) ..	2 1 <i>3</i>	Burmese rice meal ..	3 0 <i>1</i>
Wheat middlings ..	2 2	English oats ..	3 2 <i>1</i>
English linseed cake ..	2 2 <i>1</i>	Argentine oats ..	3 2 <i>1</i>
Wheat sharps ..	2 4 <i>1</i>	Egyptian rice meal ..	3 3 <i>1</i>
English beans ..	2 4 <i>2</i>	Feeding treacle ..	3 3 <i>2</i>
Maize germ meal ..	2 5	Calcutta white peas ..	3 6 <i>1</i>
Wheat bran ..	2 5 <i>1</i>	Linseed oil ..	3 7 <i>1</i>
Malt culms ..	2 5 <i>1</i>		

TABLE III.
PRICES PER FOOD UNIT. LIVERPOOL.

	s. d.		s. d.
Ground-nut cake ..	1 6 <i>1</i>	Argentine maize ..	2 7 <i>1</i>
Soya bean cake ..	2 0	Burmese rice meal ..	2 8
Palm-nut kernel cake ..	2 0 <i>1</i>	American maize ..	2 8 <i>1</i>
Coconut cake ..	2 1 <i>1</i>	English beans ..	2 9 <i>1</i>
Decorticated cotton cake ..	2 1 <i>1</i>	Egyptian cotton cake ..	2 11
Indian linseed cake ..	2 1 <i>3</i>	Maize meal ..	3 1 <i>1</i>
Wheat pollards ..	2 3 <i>1</i>	Bombay cotton cake ..	3 2 <i>1</i>
English linseed cake ..	2 3 <i>1</i>	Argentine oats ..	3 2 <i>1</i>
Wheat bran ..	2 4 <i>1</i>	English oats ..	3 3 <i>1</i>
Chinese beans ..	2 4 <i>2</i>	Linseed ..	3 4 <i>2</i>
Wheat sharps ..	2 5 <i>1</i>	Feeding treacle ..	3 7
Wheat bran (broad) ..	2 6	Linseed oil ..	3 10
Malt culms ..	2 7	Cotton seed oil ..	4 4 <i>1</i>
Maize germ meal ..	2 7 <i>1</i>		

TABLE IV.

PRICES PER FOOD UNIT. HULL.

	s. d.		s. d.
Brewers' grains (wet)	1 5	Cotton seed	2 8
Ground-nut cake	1 7½	Egyptian rice meal	2 9½
Soya bean cake	1 10	Egyptian cotton cake	2 10½
Brewers' grains (dried)	2 0½	English dun peas	2 10½
Wheat middlings	2 1½	Linseed	2 11½
English linseed cake	2 2	English maple peas	2 11½
Malt culms	2 3½	Maize meal	3 0½
Wheat sharps	2 4½	Bombay cotton cake	3 0½
Wheat bran	2 5½	English oats	3 2½
English beans	2 5½	Linseed oil	3 5½
Wheat bran (broad)	2 6½	English feeding barley	3 7½
Argentine maize	2 7½		

TABLE V.

PRICES PER FOOD UNIT. BRISTOL.

	s. d.		s. d.
Ground-nut cake	1 7½	English beans	2 6½
Maize gluten feed	2 0½	Maize germ meal	2 6½
Palm-nut kernel cake	2 2½	Argentine maize	2 7½
Brewers' grains (dried)	2 3	Egyptian rice meal	2 9
English linseed cake	2 3½	Egyptian cotton cake	2 11½
Malt culms	2 4	Maize meal	2 11½
Wheat bran	2 4½	English feeding barley	3 0½
Wheat sharps	2 4½	English oats	3 1½
Wheat bran (broad)	2 5	Argentine oats	3 2½
Wheat middlings	2 5	Linseed oil	3 11½

TABLE VI.

AVERAGE PRICES PER FOOD UNIT.

	s. d.		s. d.
Brewers' grains (wet)	1 4½	Argentine maize	2 7½
Ground-nut cake	1 7½	Egyptian cotton seed	2 7½
Soya bean cake	1 11	American maize	2 8½
Maize gluten feed	1 11½	English dun peas	2 9
Decorticated cotton cake	2 0½	Burmese rice meal	2 10½
Coconut cake	2 1	Egyptian cotton cake	2 10½
Indian linseed cake	2 1½	Egyptian rice meal	2 11½
Palm-nut kernel cake	2 1½	English maple peas	2 11½
Brewers' grains (dried)	2 1½	Linseed	3 0½
Chinese beans	2 1½	Maize meal	3 0½
English linseed cake	2 2½	Bombay cotton cake	3 1½
Wheat middlings	2 3	Argentine oats	3 2½
Wheat pollards	2 3½	English oats	3 2½
Wheat sharps	2 4½	English feeding barley	3 4
Wheat bran	2 5	Feeding treacle	3 5½
Malt culms	2 5	Calcutta white peas	3 6½
Wheat bran (broad)	2 6	Linseed oil	3 8½
Maize germ meal	2 6½	Cotton seed oil	4 4½
English beans	2 6½		

TABLE VII.

(1) Name of Feeding Stuff.	(2) Nutritive Ratio.	(3) Protein.	(4) Fat.	(5) Per cent. digestible Carbo- hydrates and Fibre.	(6) Starch equiv. per 100 lb.		(7) Linseed equiv. per 100 lb.
					Per cent. digestible.	Starch equiv. per 100 lb.	
<i>Foods Rich in both Protein and Oil or Fat.</i>							
Ground-nut cake ..	1: 0'8	45'2	6'3	21'1	77'5	102	
Soya bean cake ..	1: 1'0	31'0	6'5	21'0	66'7	88	
Decor, cotton cake ..	1: 1'2	34'0	8'5	20'0	71'0	93	
Linseed cake, Indian ..	1: 1'9	27'8	9'3	30'1	77'1	101	
Linseed cake, English ..	1: 2'0	26'7	9'3	30'1	76'0	100	
Cotton cake, Egyptian ..	1: 2'1	15'5	5'3	20'0	40'0	53	
Cotton cake, Bombay ..	1: 2'5	13'1	4'4	21'5	37'6	49	
Malze gluten feed ..	1: 3'0	20'4	8'8	48'4	87'4	115	
Brewers' grains, dried ..	1: 3'5	14'1	6'6	32'7	50'3	66	
Coconut cake ..	1: 3'8	16'3	8'2	41'4	76'5	101	
Palm-nut kernel cake ..	1: 4'6	12'5	7'7	39'0	69'5	90	
Linseed ..	1: 5'9	18'1	34'7	20'1	119'2	157	
<i>Fairly Rich in Protein, Rich in Oil.</i>							
Maize germ meal ..	1: 8'5	9'0	6'2	67'2	81'0	107	
Rice meal ..	1: 9'4	6'8	10'2	38'2	68'4	90	
<i>Poor in Protein, Poor in Oil.</i>							
Peas, Calcutta white ..	1: 2'1	23'3	1'1	45'9	66'9	88	
Beans, English ..	1: 2'6	10'3	1'2	43'2	67'0	88	
Beans, Chinese ..	1: 2'6	19'6	1'7	47'9	67'0	88	
Peas, English maple ..	1: 3'1	17'0	1'0	50'0	70'0	92	
Brewers' grains, wet ..	1: 3'5	3'5	1'5	8'6	12'7	17	
Malt culms ..	1: 3'6	11'4	1'1	38'6	38'7	51	
<i>Cereals, Rich in Starch, not Rich in Protein or Oil.</i>							
Barley, feeding ..	1: 8'0	8'0	2'1	57'8	67'9	89	
Oats, English ..	1: 8'0	7'2	4'0	47'4	59'7	79	
Oats, Argentine ..	1: 8'0	7'2	4'0	47'4	59'7	79	
Maize, American ..	1: 11'5	6'7	4'5	65'8	81'0	107	
Maize, Argentine ..	1: 11'3	6'8	4'3	65'8	83'5	110	
Maize meal ..	1: 12'0	5'5	3'5	63'9	77'8	102	
Wheat middlings ..	1: 5'3	12'0	3'0	56'0	59'1	78	
Wheat sharps ..	1: 5'6	12'0	4'0	50'0	58'4	77	
Wheat pollards ..	1: 5'3	11'6	3'5	53'0	54'3	71	
Wheat bran ..	1: 4'7	11'3	3'0	45'0	49'7	65	
Wheat bran, broad ..	1: 4'7	11'4	3'0	45'4	48'1	63	

For Bullocks.—Linseed cake and bean meal are not much dearer per food unit at the present time than other foods, and it would not entail much extra cost to replace part of the concentrated ration by 2 lb. of these well-tried foods in order to put a finish on bullocks nearly ready for the butcher. For less forward bullocks the rations recommended last month are not likely to be improved upon at the moment.

Where it is necessary to limit the root ration to not more than about 56 lb., ground nut cake is too concentrated to use alone. The cheapest starchy food to mix with it is probably tail corn, where this is available. These foods should be mixed in equal proportions, and used at the rate of about 7 or 8 lb. per head per day.

Ewes with Lambs on Grass.—Ewes under these conditions will probably get a few mangolds, and are likely to show signs of scouring. The cheapest concentrated food to give them at present prices in order to keep their digestive organs in a healthy condition is 1 lb. per head per day of beans or peas.

Rations for other Stock as last Month.

THE rain and snow towards the end of February had the effect of bringing heavy soils into a sticky condition, and this effectually prevents the water from getting away and

Notes on Manures in March: may injure the winter corn. Soils that have

From the Rothamsted Experimental Station. been well chalked or limed are less likely to suffer than others, and farmers on the red, flinty clay overlying the chalk in Kent,

Surrey, Hants, Bucks, Herts, etc., will do well to note the fields that get into this state with a view to chalking or liming next autumn, if it then proves at all possible to do it. Further, such land should be subsoiled, if possible, when next it comes under roots or potatoes. Until the water has been got away it will be of little use to apply top-dressings.

It has been ascertained at Rothamsted that the loss of nitrate from the soil during the past winter has been considerable. This has to be made good, and this year the need of spring manuring is greater than usual. Farmers who have not yet top-dressed their wheat or winter oats should do so without delay.

Prices of Manures.—As compared with last month prices continue to rise, except in the case of 93 per cent. sulphate of ammonia, which shows a fall. Nitrohm and nitrate of lime are both higher in price, although where they can be obtained they still remain the cheapest of the quick-acting nitrogenous manures. Other manures are also rising, and farmers who bought early are reaping the advantage of their action. For the time being, however, farmers are not restricted to the quick-acting manures. It is not too late to use organic manures, provided they are easily available, in fine condition, and are worked into the soil. Attention may here be directed to whale guano, an organic manure now obtainable, which has not hitherto been much used in this country: although a British product it has been shipped to the Continent and America. It contains from 8 to 10 per cent. of ammonia and 20 to 30 per cent. of phosphates: it resembles fish guano in a general way, but contains a fair amount of oil—about 17 per cent. There is a widespread opinion that

oil is injurious to manure, but little direct evidence in support of the view: on the other hand oil has no manurial value and would only be wasted in the soil even if it proved harmless. Samples of the above composition would, at present prices of other manures, be worth about £8 to £10 per ton: they could be used for roots, potatoes and special crops, such as hops, etc.

Schemes of Manuring for Crops.—The farmer should by now be in a position to draw up his scheme for manuring. The main point to bear in mind is the imperative need of getting as much produce as possible out of the land.

Wheat.—This crop responds well to kindly treatment, and, under present conditions, liberal manuring is most emphatically desirable. There are two common cases, one being that in which the land involved can produce 40 bush., but commonly only yields 30 bush. or less. A good deal of land of this description is found on the boulder clay of the Midlands, and the flinty clay of the Home Counties. In days gone by some of it was accounted good wheat land, but years of low prices have caused the crop to lose its former position. The most satisfactory manure for wheat on this land is farmyard manure, but this cannot usually be spared, and in any case it could not go on now. The next best thing is to give a suitable dressing of artificials. For the heavier soils it is, in most seasons, desirable to apply phosphates, and this year the need is increased by the wetness of December and February: the phosphates help in root development and enable the plant to start growth early. A suitable dressing is 2 to 4 cwt. of superphosphate (the smaller dressing for rather dry conditions, the larger one for wet conditions), and 1 to 2 cwt. of nitrate of soda or sulphate of ammonia, or, if the tilth is bad, 30 bush. of soot. The larger dressings must be given in two applications and not all at once.

These dressings are heavy: in peace times they might be considered too heavy to give any profitable return, but the special conditions justify high manuring.

In Rothamsted experiments the increases shown in the table on p. 1283 have been obtained by the use of top-dressings of sulphate of ammonia and nitrate of soda. The years given in the table are chosen because the rainfall conditions were similar to those of the present season, the rainfall, 1st October—10th February, having been 13·7 in.

On lighter soils there is less need for phosphates, and none need be given if the preceding crop was roots or potatoes receiving 3 or 4 cwt. of superphosphate or bone meal. If no phosphates

have been applied for 2 or 3 seasons it is desirable to give 2 cwt. of superphosphate.

One to 2 cwt. of sulphate of ammonia or nitrate of soda should also be given, and, if the land is likely to scorch, or if kainit is known to be beneficial, 2 cwt. of salt would probably prove beneficial.

In districts of low rainfall, however, these dressings may not prove remunerative. Farmyard manure is probably the best manure under the circumstances.

In regard to soils that normally produce 40 to 50 bush. of wheat no general advice can be given. On the land of the brick-earth type, producing large heads well set with corn and borne on

BROADBALK WHEAT.—*Bushels of Grain per Acre.*

Year of Crop.	Rainfall: Inches, 1st Oct. to 10th Feb.	Minerals and					
		Minerals alone.	Am- monium Salts.	Double Am- monium Salts.	Treble Am- monium Salts.	Nitrate.	Double Nitrate.
		Plot 5.	Plot 6.	Plot 7.	Plot 8.	Plot 9.	Plot 10.
1897	14.1	12.8	19.4	28.6	36.9	25.8	27.5
1900	13.2	12.8	19.3	29.8	44.9	23.7	34.9
1907	13.9	11.5	23.9	33.6	34.7	39.2	34.7
1911	13.6	14.8	17.1	25.6	36.4	29.9	39.1
Average in- crease per acre due to Nitrogen.		—	7.0	16.4	25.0	14.4	21.4

stiff straw, it may be safe to try and increase the yield by means of a dressing of 1 cwt. of sulphate of ammonia or nitrate of soda. On lighter soils that were heavily sheeped last year there might, however, be risk of having the crop laid.

If a second wheat crop is being taken, the following manurial ingredients in lb. per acre would return to the soil all that is removed.

Grain only sold :	Phosphate as Phosphoric Acid.				Tricalcic Phosphate.		Potash. lb.	
	30 bushel crop	34	..	14	..	31		
	40	..	49	..	19	..	42	
Grain and Straw sold :								
	30 bushel crop	..	50	..	21	..	40	
	40	..	67	..	28	..	61	

The spring dressings suggested above would supply all the phosphate and much of the nitrogen required, and sufficient potash would usually be contained in the dung applied to the following root crop to maintain the fertility of the soil.

Oats.—Oats, like wheat, respond well to liberal treatment. They require an all-round dressing, and, as a result of various trials, the following is usually recommended:—2 to 3 cwt. of basic slag or superphosphate, and 2 cwt. of kainit, worked in with the seed, and 1 to $1\frac{1}{2}$ cwt. of nitrate of soda or sulphate of ammonia applied later on. The need for kainit is reduced by dressings of dung, but if no dung was applied in autumn, and if kainit is known to be essential, then 2 cwt. of salt may be substituted.

Basic slag is less generally useful than superphosphate for spring oats, but it answers on naturally wet land, such as some of the moorlands in the West of Scotland.

"Seeds."—Careful inspection of the "seeds" should now be made, and if it appears that the clover has suffered badly through the wet winter, and is obviously not going to do well, an effort should be made to obtain a good growth of the grass. This can be done by applying $1\frac{1}{2}$ to 2 cwt. of nitrate of soda or sulphate of ammonia. If liquid manure is available it might be used instead, unless it is all wanted for the permanent grass land.

Unit Prices of Artificial Manures in March.—The statement on p. 1285 shows the cost to the purchaser of 1 per cent. per ton of nitrogen, and soluble and insoluble phosphates derived from various sources, at certain ports and manufacturing centres, for March, 1916.

NOTE.—These unit prices are based on the *probable* retail cash prices in bags f.o.r. for quantities of not less than 2 tons of the manures mentioned at the ports and places specified, but it should be borne in mind that market prices are fluctuating considerably at the present time. The prices are published by the Board of Agriculture and Fisheries for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of the manures mentioned if the unit prices of the constituents of the manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

THE Soya Bean (*Glycine hispida*) is a sub-erect or creeping leguminous plant, somewhat resembling the "French Bean" in appearance and habit of growth. It is a native of Eastern Asia, and has been grown for a long period in China and Japan, where the bean is used for human consumption, its high content of albuminoids and oil making it particularly valuable as a supplement to starchy foods such as rice.

The soya bean, which is a round, yellowish seed about the size of a field pea, was not imported in any considerable quantity into this country before 1908. It is, itself, used here to some extent as a cattle food, but as a rule the greater part of the oil is first removed by seed crushers, the residual cake or meal being used for feeding purposes. The following are analyses of the soya bean and of soya bean cake, in comparison with the English bean and decorticated cotton cake.

	Soya Bean.	English Bean.	Soya Bean Cake.	Decort. Cotton Cake.
Albuminoids ..	36	25	43	41
Oil	17	1½	6	9
Carbohydrates ..	26	48	28	26
Fibre	5	7	5	8

Experiments with soya bean cake tend to show that, when fed in moderation, it is a useful feeding stuff; otherwise it is apt to prove distinctly laxative. For this reason it is usually given along with undecorticated cotton cake. At present prices it is one of the cheapest feeding stuffs on the market. See also p. 1277 of this *Journal*.)

The following table gives the imports of soya beans, and their value in respect of the years ending 31st December, 1912, 1913, 1914 and 1915:—

Quantities in tons.

1912.	1913.	1914.	1915.
188,760	76,452	71,161	175,136

Value in £ sterling.

1912.	1913.	1914.	1915.
1,567,960	635,747	593,190	1,461,525

Few of our home-grown foodstuffs approach the soya bean in value, and it is clear that if it could be grown successfully in this country, it would soon find a place in ordinary farm practice.

Previous to 1909 a few attempts had been made to grow the crop in England, but without any success; at best, the plants grew up to flowering stage but formed no seed. About this

time, with the object of securing the hardiest sorts in cultivation, the Board obtained from an experiment station in North Japan, seed of 16 varieties, together with a small quantity of soil in which the crop had been grown. These were sown at the Midland Agricultural and Dairy College and on the Cambridge University Farm. At both centres the results were similar—many of the varieties grew well, but none formed flowers. Where the Japanese soil had been applied the nodule formation was all that could be desired, but where no inoculation had taken place, no nodules were formed.

In 1910 the Board obtained seed of several varieties from Manchuria. These were grown at the same centres as before. At the Midland College the crop grew vigorously, but formed no seed, while at Cambridge the plants ripened a small quantity of seed. This seed was sown in 1911, but the crop made little growth, and in spite of the hot season no seed was produced.

These results prove conclusively that the Japanese and Manchurian varieties hitherto tested cannot be relied upon to produce seed in this country. As the plant appears to be a very variable one, however, it is not impossible that a variety suited to conditions in this country may yet be produced.

In some experiments at Wye College, Kent, with seed supplied by the Macdonald College, Quebec, well-filled pods were produced in 1910, from a variety known as "Early Tennessee," when the soil was inoculated.

Apart from seed production the plant might have some value in this country as a forage crop. It appears to resist drought well, and is largely grown in the United States for green fodder, which appears to be liked by all classes of farm stock. In general composition the green plant resembles clover.

In America the early varieties mature in the northern part of the corn belt, but frequently do not yield sufficiently to warrant growing them for seed. Farther south, however, they can be profitably cultivated for seed. Generally speaking, the soya bean requires about the same temperature as maize.

THE following note has been communicated to the Board by
Mr. B. P. Davis, F.T.C.:—

Granular nitrolim differs materially from
The Use of nitrate of soda, and in some respects from
*Granular Nitrolim.** sulphate of ammonia.

Generally speaking, it may be observed that nitrolim gives

* A summary of some recent experiments with granular nitrolim will be found on pp. 1296 and 1301.

best results when harrowed into the soil, and this, together with early application, is a point to be remembered. There is no fear of its being washed out of the soil, and hence, if applied early, not only will the nitrogenous compound have an opportunity of becoming thoroughly incorporated in the soil, but the free lime which it supplies (40 per cent.) will also be able to exert its beneficial action.

As a top dressing for winter wheat nitrolim should be applied (1 to $1\frac{1}{2}$ cwt. per acre) in early spring, preferably just before the first harrowing of the wheat; for grass land (hay), from the last week of February to the middle of March is the most suitable time.

For spring-grown cereals (1 to $1\frac{1}{2}$ cwt.) and root crops (2 cwt.) nitrolim should be broadcasted just before, or at time of sowing, and for potatoes, it may be mixed with superphosphate (and potash when available) and broadcasted over the drills before the tubers are planted and the ridges split back. It is not advisable to apply it as a top dressing to mangolds, and for cabbage (2 cwt.) it should be applied between the rows and not over the plants.

With regard to mixing with other fertilisers, the following points may be noted:—

Nitrolim makes an excellent mixture with basic slag, no chemical changes taking place at all; it mixes equally readily with bone meal, steamed bone flour, potash salts and common salt. It is not recommended, however, that a mixture of nitrolim and salt should be stored for any length of time; it is better to mix them only a reasonable time before application. Nitrolim must not be mixed with sulphate of ammonia, but mixes well with nitrate of soda. Its behaviour with superphosphate depends to a certain extent on the proportions used and the condition of the superphosphate. In proportions of, say, one of nitrolim to four of superphosphate, where the latter is in good dry condition, an excellent texture is obtained, with very little (if any) development of heat and certainly no loss of ammonia. In equal proportions with damp superphosphate, considerable heat may be developed and steam may be given off, but even then it is unlikely that any loss of ammonia would occur. A certain amount of reversion may take place, but the reverted phosphate is still citric soluble and available as plant food. It is recommended that, where convenient, the mixture should be made just before application, especially when a higher proportion of nitrolim than one to four is being employed.

THE residue left after acetylene gas has been made from calcium carbide consists substantially of calcium hydrate, *i.e.*, slaked lime, containing from 30 to 40 per cent. of water. The dry matter contains 60 per cent. or more of CaO (as compared with 80 to 90 per cent. in the case of a good quicklime).⁸

Calcium Carbide Residue for Liming. The impurities usually found in calcium carbide are small quantities of silicon, sulphur, iron, phosphorus and carbon, but not such as will render the residues generally unsuitable for agricultural purposes if proper care is taken.

A sample of *fresh* calcium carbide residue recently examined at the Government laboratory was found to contain small quantities of calcium sulphide and calcium sulphocyanide, but no other substance likely to be poisonous to plant life was detected. In a *weathered* sample of the same residue only a faint trace of calcium sulphide was found, indicating that exposure rapidly oxidises the sulphide; and only 0.001 per cent. of calcium sulphocyanide was found, it being probable that, since the latter is soluble in water, the rain washed out the greater portion of this substance during exposure. The residues from generators are usually put into heaps, but it should not be assumed that such heaps become weathered. If little or no attempt is made at aeration, the great bulk of the sulphide probably remains unoxidised after the lapse of a considerable time owing to the caking of the hydrate on the outside of the heap.

On weathering, the calcium hydrate would, to some extent, probably be converted into carbonate, but the carbonate would be in a finely divided condition and readily decomposed by soil acids. Its action would, therefore, differ only slightly from that of hydrated lime.

In substituting calcium carbide residue for lime it is recommended, therefore, that the use of *fresh* carbide residue should in all circumstances be avoided.

After exposure to the weather, the carbide residue is best applied to fallow ground during the winter; trials on a small scale should be made before any growing crop is dressed with the residue.

The carbide residue may be applied in the same quantities (when dry) as ordinary quicklime. It should not be mixed with farmyard manure, or loss of ammonia from the latter will result; indeed, it should be put on the field a few months before the farmyard manure.

* In a note in this *Journal* for October, 1915, p. 699, it was stated inadvertently that "the dry matter contains about 60 per cent. of quicklime, *i.e.*, about 50 per cent. of CaO." The words in italics should not have appeared

IN the article on seed testing which appeared in this *Journal* for February, 1916, p. 1055, reference to the work done at Aberystwyth was inadvertently omitted.

Seed Testing at Aberystwyth. The testing of farm seeds at Aberystwyth

endeavours to arouse amongst farmers a greater interest in the care of grass land generally. The most hopeful sign for the future is felt to be the fact that an increasing number of farmers' co-operative societies seek advice from the College in the matter of purchasing their seeds. Two societies regularly send their samples to be tested, whilst four local societies have sought advice as to the mixtures most suitable to the needs of their members. This season three local merchants have already sent samples to be tested, whilst two have made inquiries to the mixtures most suitable to the needs of their clients.

It must be pointed out that many of the co-operative societies in the College area have long realised the importance of good seed and well-balanced mixtures, and that the early pioneer work of such societies has been of great value. Many local merchants have also done much to persuade farmers to purchase seeds of high quality. There is, however, still room for very great improvement, especially in certain localities.

There are fully adequate facilities for seed testing at Aberystwyth, the work being undertaken by Mr. R. G. Stapledon, M.A., Agricultural Department, University College of Wales, Aberystwyth. Samples should be sent to Mr. Stapledon, or to the Agricultural Organiser for the several counties covered by the College (Brecon, Cardigan, Carmarthen, Merioneth, Montgomery, Pembroke, Glamorgan, Monmouth, and Radnor).

No charge is made to farmers in the College area, but 1s. per sample is payable by co-operative societies and merchants resident in the area. A complete report includes the percentages of purity, germination and real value; particulars as to weed seeds and "hard" seeds are also given, and, when desirable, also as to the probable age of the sample.

A special endeavour was made to collect samples in 1913, and 370 samples were examined; 205 samples were examined in 1914, and 270 samples in 1915.

The benefits are beginning to be apparent in the district, the most noticeable feature being the greater care taken by many

farmers in the purchase of cocksfoot, and home-grown clovers in particular. There is also a tendency to discontinue the use of rye grasses of very low bushel weight.

THE Board have recently sent the following memorandum to a correspondent in reply to an inquiry as to grazing in common:--

1. There are many tracts of land in **Grazing in Common**, England where the ownership of the soil is held by one person subject to certain pasture-rights, possessed by other persons called commoners, which rights are exercisable in some cases throughout the year, and in other cases after the crops are taken. These pasture-rights are in some cases attached to a particular farm or tenement, and measured by the number of beasts which the commoner is able to keep on his own farm or tenement in the winter by the produce raised on the farm during the summer; but in many other cases the pasture rights are fixed or "stinted" to a specified number, and are in such cases capable of being bought and sold apart from the farm or tenement to which they originally belonged.

2. As to the "rules and regulations" governing such common land, these are in most cases in England made on a voluntary basis by the persons concerned, without the cognisance of any local or central administrative body, and deal—as far as the Board are aware—with arrangements, suited to the particular local conditions, prescribing the kind of animals that may be turned out on the common pasture and the times at which they may be so turned out, etc. In a small number of cases, the owner of the soil and the commoners have voluntarily applied to the Board to adjust their rights, under the provisions of the Commons Act, 1876; but there is no compulsion by the State in the public interest on them to have the rights adjusted, which probably in many cases remain in a confused and obscure condition. The number of applications to the Board under that Act has decreased; less than 50,000 acres have been regulated under it as contrasted with the 2,000,000 acres assumed by a House of Commons Select Committee in 1913 (H.C.R. 85 of 1913), to represent the common or waste land in England and Wales. As a specimen of by-laws confirmed under that Act by a central administrative body, the Burington by-laws of 11th May last, affecting about 1,000 acres in the County of Somerset, may be mentioned.

3. In the Small Holdings and Allotments Act, 1908, provision has been made for the creation of common pasture, but up to the present time this provision has not been used to any considerable extent.

THE Board have received a report of a sale of farming stock belonging to Mr. John Gifford, Middle Farm, Tarlington, Somerset. The special interest of the sale

Sale of Cows with Milk Recording Certificates. is the fact that it is the first in which the Milk Records Certificates issued by the Board were referred to by the Auctioneer and handed by him at the sale to purchasers.

The cows are reported to have made from £2 to £4 per head more than they would have done had they been sold without certificates, and the vendor is satisfied that the possession of the certificates for the cows resulted directly in a net increase in the total prices obtained of approximately £200. Mr. Gifford is a member of the North Cadbury Milk Recording Society, which was the first to start operations under the Board's Milk Recording Scheme, and the result of his sale shows that a Milk Recording Certificate as issued by the Board has a commercial value. These certificates are only issued after the Board have satisfied themselves that the records of milk yields have been kept in accordance with their Regulations, which provide for supervision and independent checking. The Board hope that when the commercial value of their certificates is generally realised, a considerable stimulus will be given to Milk Recording throughout the country.

A BARE fallow can never be a directly profitable operation and has no justification on free-working land. But with strong

Reduction in Bare Fallow. clays in dry climates, as for example over

much of the East and South-East of England, a bare fallow may sometimes be necessary to clean the land and restore its friable texture; on such soils also there is least likelihood of loss through the washing out of the reserves of nitrogen which have been rendered available by the process. Bare fallowing may in such a case be useful.

Under present conditions, however, bare fallowing should be reduced to the narrowest possible limits. At a low estimate a bare fallow will cost about £2 per acre for cultivations alone, to say nothing of rent, rates, taxes and, possibly, manure as well; and this assumes that enough labour will be available to make a

success of the process. It is not sufficient merely to plough or cultivate a certain number of times: each operation must be done when the conditions are most favourable for the objects in view. All things considered, therefore, it would be well, so long at least as the war lasts, to adopt bare fallowing only as a last resource and, where the land has become very foul or exhausted, to try the effect of a bastard fallow. A quick-growing crop, such as white mustard or rape, might be sown for consumption on the land by sheep receiving cake; or a smother crop, such as vetches, might be grown for soilings, ensilage, or making into hay. As soon as possible after the removal of such crops the land should be broken up and exposed to the weather in preparation for autumn corn. If such catch crops are well manured with nitrogenous and phosphatic fertilisers the labour and expense of autumn cleaning will not, as a rule, be great.

As the home supply of eggs for next winter depends to a great extent on the hatching results of the next few weeks, it is very important that preparations should

Hatching of Chickens. be made for hatching and rearing as large a number of useful chickens as possible.

During the present season the poultry-keeper should endeavour to secure chickens from strains which will improve the quality of his present stock; he should prepare to increase the stock where this is practicable, and special attention should be devoted to the management of the chickens. The cost of rearing the birds is higher than usual, but the return for the produce has also been higher than in normal times, and there is a reasonable prospect of a steady demand at prices which are likely to prove satisfactory. Poultry-keepers should exercise economy, not by reducing their output, but by producing a better quality of chicken so that for the same expenditure on food they may obtain a higher return in produce.

During the rearing season a strict system of selection should be practised, and all weakly and unsuitable birds should be killed so as to reduce unnecessary expenditure on food and labour. The production of larger numbers of chickens of good quality during the present hatching and rearing season may be commended to poultry-keepers as a form of service which is likely to prove of value. In this connection reference may be made to Leaflet No. 305 (*Selection of Poultry for Breeding Stock and the Hatching of Chickens*) and Special Leaflet No. 54 (*The Rearing of Chickens*), copies of which may be obtained free on application.

IN a book* recently published, dealing with Brazilian problems, it is urged that the prosperity of Brazil in the future can best be assured by making the collection and preparation of rubber in the Amazon basin for export subsidiary to agriculture, stock raising, and other industries, and not the main, and, in fact, the sole industry that it can well claim to be at present. It is pointed out that rubber is no longer a commodity of which Brazil holds a monopoly, and the same is true to a certain extent of cacao, grown in regions further south than the Amazon.

Brazil possesses large areas of cheap and productive lands which are not at present utilised, while, on the other hand, the increasing demand for food stuffs is instrumental in maintaining a high cost of living. The great cost of producing rubber is largely due to the high price of meat, fresh meat (except that which comes from the forest) being unobtainable in the rubber districts. It is, therefore, suggested that the course to which Brazil will be forced will be to ditch, drain, break up, and cultivate the flat, open lands in the rubber zone, and to clear and drain the forest areas. The agricultural resources would be best developed by hard-working settlers, rooted to the soil as owners of small homesteads, and who would augment the income so obtained with the profits from rubber gathering. For this purpose it is stated that immigrants will have to be encouraged, whether Indian, Negro, Japanese, or Chinese.

Further, to keep her grip on the world's demand for her products, especially rubber, Brazil must have a much larger population, but this again points to the need for first increasing the amount of home-grown food stuffs; with larger supplies of meat and milk (which are an important adjunct to the food even of the labouring classes) the infant mortality will be reduced, and healthy, strong, and vigorous families reared.

The possibility is alluded to of the eventual establishment of an export trade in meat products, especially of pig products from the Amazon, but what is wanted at present is an increased meat supply for the local population. Various tropical crops are recommended for the proposed small holdings on the Amazon, and the produce (e.g., ground nuts, maize, lucerne) would be used in part to supplement food stuffs for animals.

It is recognised that the work of developing a dairy or cattle-breeding industry in the Amazon will be an uphill task; to evolve a sound, remunerative industry spread over a large area is a big undertaking, even with pasture land, etc., ready to receive the animals; whilst to prepare the land and discover the food supplies for the cattle around many of the settlements attached to the *estradas* is thought to be impossible at present, although it is hoped that this will not always be the case.

The volume also contains particulars relating to live stock in Brazil, and the introduction of various foreign breeds of cattle. Information on the subject has been published in this *Journal* on several occasions;† mainly with a view to indicate the demand which exists, and the

* The Rubber Industry of the Amazon, and How its Supremacy can be Maintained, *J. F. Woodroffe and Harold Hamel Smith*. London: John Bale, Sons and Danielsson, Ltd., 1915.

† See this *Journal* for March, 1915 (p. 1079); May, 1913 (p. 167); November, 1911 (p. 695); December, 1910 (p. 766); March, 1910 (p. 1016).

prospect of increasing the export of British pedigree animals to that country. The following additional details are taken from a recently issued official publication* :—

The Federal Ministry of Agriculture, as well as private breeders, have shown a marked interest in the question of the improvement of the native stock through the admixture of foreign blood. Brazil may be said to have three different climatic zones, and great difficulty has been experienced in selecting the foreign breeds suitable to these various zones. The greatest difficulty has been the stamping out of the red-water fever, which on some ranches attacked 80 per cent. of the cattle and frustrated the first attempts to import foreign cattle. The zootechnical station at Pinheiro is paying especial attention to this question, and claims that fatal cases of fever in their station do not exceed 7 per cent. Although a certain amount of British stock is imported, there seems to be a preference in favour of Limousin, Swiss, and Dutch breeds as being better able to resist red-water fever.

The central zootechnical station of the Republic is at Pinheiro, whence selected breeds are distributed to the minor stations in São Paulo, and Minas Geraes, as well as to individual breeders who prefer to take advantage of the import bounties offered them. Two other stations now exist at Lages, in Santa Catharina, and at Ribeirão Preto, in São Paulo.

Four model farms are being set up at Santa Monica in the State of Rio de Janeiro, Ponta Grossa in Paraná, Uberaba in Minas, and at Caxias in Maranhão. The Santa Monica farm has already 603 head of cattle and horses, and at Ponta Grossa there are a number of Southdown sheep.

Subsidies are granted by the Federal Government to importers of certain European animals, including horses, asses, swine, sheep and goats; but no importer can receive bounties on more than 10 head annually. In order to receive the grants, the importer has to obtain approval of the breeds selected, and the animals must be in perfect health, and accompanied by pedigree and veterinary certificates. The documents must be legalised at a Brazilian Consulate in the country of origin, and must be accompanied by two photographs of each animal.

The Brazil Land, Cattle and Packing Company, which is affiliated to the Brazil Railway Company, imported in 1912 a large herd of Shorthorns and Herefords from Texas, United States of America. The experiment is reported to have been highly successful, and comparatively few of the cattle contracted red-water fever. Those of the cattle imported from the non-fever districts of the United States did not escape the fever, but the majority recovered.

The Russian Government have recently adopted new regulations which require that live stock imported from the United Kingdom must

Exportation of be accompanied by an official certificate
Live Stock to testifying that during the preceding six weeks
Russia. the districts from which the animals are
exported have been free from the following
contagious diseases, viz : anthrax, glanders,
and farcy, in respect of horses ; anthrax, cattle plague, foot-and-mouth

* Foreign Office Report on the Trade of Brazil, Annual Series, No. 5451.

disease, and pleuro-pneumonia, in respect of cattle; anthrax, foot-and-mouth disease, and sheep-pox, in respect of sheep and goats; and anthrax, foot-and-mouth disease, and swine-fever, in respect of pigs.

In order to obtain the official certificate, intending exporters of live stock from Great Britain must apply to the Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W., for forms of application, which should be returned, duly completed, and accompanied by a certificate, signed by a duly qualified veterinary surgeon, testifying that the animals are in good health, and free from contagious or infectious disease; and that the premises from which the animals are exported have been free from infection during the previous six weeks. These certificates will not require Consular endorsement.

In the case of cattle, a separate certificate is required, indicating that each animal has successfully passed the tuberculin test. This document must be endorsed by a Russian Consular Officer.

Official certificates for live stock exported from Ireland, whether the animals are sent direct or transhipped in Great Britain, are issued by the Secretary, Department of Agriculture and Technical Instruction for Ireland (Veterinary Branch), 50 & 51, Upper Mount Street, Dublin.

Live stock exported to Russia from other countries (e.g., the Channel Islands) through the United Kingdom must be accompanied by an official certificate from the Authorities of the country of origin, as regards the non-existence of disease in the districts from which the animals come; and a certificate of health signed by a local Government Veterinary Surgeon. A tuberculin certificate is also required in the case of cattle; and all these documents must be endorsed by a Russian Consular Officer.

The exportation of live stock from the United Kingdom is at present prohibited by Order in Council, but applications for export licences may be made to the War Trade Department, 4, Central Buildings, Westminster, S.W.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Granular Nitrolim and Nitrate of Lime.—(*Midland Agric. and Dairy Coll. Rept. on Field Trials, 1915.*)—The following remarks are made in the Report as to these manures:—

“Granular nitrolim is a new form of nitrolim put on the British market in 1914 for the first time. It is a dry, granular material, not nearly so dusty as the original nitrolim, and consequently much easier and pleasanter to handle. Our trials have shown that it is unaffected by the atmosphere, that it can be safely mixed with superphosphate without the mixture becoming hot, that it forms a dry, friable mixture

* A summary of reports on agricultural experiments and investigations is usually given in the *Journal*. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

which will remain in good sowing condition for some time. Altogether it is a very convenient manure to handle, and a great improvement on the original nitrolim.

" It contains 15½ per cent. of nitrogen; it also contains a considerable percentage of lime, which is often an advantage, but makes it unfit for mixing with any manure containing ammonia, such as sulphate of ammonia, guano, etc.

" Nitrate of lime has been on the market for several years, and is now more generally known. It is a greyish material containing 12½ per cent. of nitrogen, and also about 25 per cent. of lime.

" Its great drawback is that it tends to absorb moisture from the air, and to become wet and sticky, and it then has a burning effect on the skin. The present product is, however, much improved in this respect, and if proper care is taken in using it no trouble need ensue.

"The following precautions should be attended to:—The barrels containing it should be stored in a dry place, and should be kept closed until the material is required. It should be sown on a dry day. If mixed with superphosphate it forms a dry and easily-sown mixture which does not become wet and sticky so quickly. Such a mixture must, however, be sown immediately after being made. This manure continues to be considerably dearer per unit than other nitrogenous manures, and this, coupled with the greater difficulty in handling it, are against its more extensive use."

Granular nitrolim was tested against sulphate of ammonia for potatoes on a light loam previously cropped with oats. The two manures were added to dressings of 15 tons dung, 3 cwt. superphosphate and 1 cwt. muriate of potash. With early varieties sulphate of ammonia ($\frac{1}{2}$ cwt.) gave a larger total yield by $\frac{1}{2}$ tons than granular nitrolim ($\frac{1}{8}$ cwt.). With a maincrop variety granular nitrolim ($\frac{1}{2}$ cwt.) gave a larger total yield by nearly 1 ton than sulphate of ammonia (1 cwt.).

The results of tests on mangolds with the manure will be found below (p. 1301).

Bacterised Peat and Sulphate of Manganese (*Midland Agric. and Dairy Coll., Rept. on Field Trials, 1915*).—Bacterised peat is sent out in two forms, viz.:—(1) As a fibrous material for incorporating with the soil, and (2) as a powder for top dressing.

The powder was applied as a top dressing to wheat and "seeds" hay at the rate of 7 cwt. per acre, but produced no result whatever on either crop.

The fibre was tested with potatoes, 5 cwt. per acre being used. The results were again entirely negative.

Sulphate of manganese was tried for "seeds" and potatoes, but with negative results.

Salts of Ammonia (*La Vie Agricole et Rurale*, abs. in "Fertilisers.")

—In experiments on the application of sulphate of ammonia at different depths the best use of the manure was obtained by burying to a depth of at least 4 in. Applied as a top dressing, the greatest proportion of nitric nitrogen remained in the upper 4 in., to the disadvantage of a tap-rooted plant such as beet. Whilst the control plot was only able to supply 5 mg. of nitric nitrogen per 100 mg. of dry earth, the manure had provided 6.8 when applied as a top dressing, 7.7 when buried at a depth of 2 in., 9.5 at a depth of 4 in., 8.8 at 7 in. and 9.1 at

Testing for Acidity of Soil with Litmus Paper (*Canadian Dept. of Agric., Chemistry Div., Bull. 80*).—In this bulletin, two methods of testing for acidity or sourness in soil by means of litmus paper are described:—

" 1. Take up, by means of a spade or trowel, a little of the surface soil from, say, half a dozen places on the area to be examined, and mix well, using the trowel or a clean piece of board. Do not handle the soil. Take a small quantity (a few ounces) of the mixed soil and, putting it in a clean cup or tumbler, pour on a little boiled water and stir with a clean piece of stick or spoon until the mass is of the consistency of a very thick paste. Into this "mud" press a piece of blue litmus paper by means of a small stick or the back of the knife, inserting the paper until one-half to two-thirds of its length is within the pasty mass. At the end of fifteen minutes carefully draw out the paper and note if the part that has been in contact with the soil has turned red. If so the soil is acid.

" 2. Place a strip of blue litmus paper in the bottom of a clean, dry, glass tumbler (preferably flat-bottomed), and over it place a round "filter paper" (purchasable at a druggist's) or, if such is not readily obtainable, a piece of clean white blotting paper cut to fit the bottom of the tumbler. On this put a few ounces of the soil to be tested, collected and mixed as already described, and pour on sufficient boiled water to moisten or wet the soil thoroughly throughout its mass, but no more, and set aside for half an hour or longer. To examine the litmus paper the tumbler is inverted; viewed through the bottom of the glass its colour will be well brought out against the white filter paper. As a check, and to ensure that any change in colour may not be due to acidity of the water or filter paper used, a blank test should be made in the same manner, but using no soil."

Soluble Humus and Productiveness of Soil (*Jour. Agric. Sci., Vol. VII, Pt. 2; W. Weir, M.A., B.Sc.*).—The soluble humus in the soil was removed by washing the soil with dilute hydrochloric acid to remove bases, and then repeatedly extracting with dilute soda. Some 40 per cent. of the nitrogen in the soils was thereby removed. Vegetation experiments were then conducted with extracted and untreated soils during two seasons, and approximately equal total yields both of dry matter and of nitrogen were obtained with each soil over four successive crops. It appeared that the removal of the soluble humus did not diminish the productiveness of the soil, in spite of the fact that the soil used was known to respond to nitrogenous fertilisers.

Laboratory experiments indicated that the removal of the soluble humus increased the amount of ammonia but diminished that of nitrates in the soil, and the sum of ammonia and nitrates was usually less in the extracted than in the untreated soil. The numbers of bacteria, however, were considerably increased. It is stated that the laboratory results are not necessarily inconsistent with the vegetation experiments; since the accumulation of ammonia and nitrate in an uncropped soil will only proceed to a certain stage, while where crops are grown the nitrate is perpetually being removed by the growing plant.

FIELD CROPS.

Varieties of Potatoes (*Edinburgh and E. of Scot. Coll. of Agric., Report 1914, Ser. A., No. 1*).—Potatoes were grown in 1914 following a wheat stubble on a medium loam soil in 1/30th acre plots. They

received 6*1* cwt. per acre of mixed artificials, supplying about 5 per cent. nitrogen, 16 per cent. soluble phosphate and 6 per cent. potash, at the time of planting, which was carried out in the third week in April. The figures given below represent the total of saleable produce.

The yields of early varieties were:—Epicure 11 tons 12 cwt.; Mid-Lothian Early 10 tons 16 cwt.; Ninetyfold 10 tons 15 cwt.; Eclipse 10 tons 2 cwt.; Sharpe's Express 7 tons 14 cwt.; New Success 4 tons 18 cwt. The quality of produce of Ninetyfold was stated to be inferior.

The second early varieties yielded as follows:—Macpherson 11 tons 7 cwt.; British Queen 10 tons 19 cwt.; King Edward 10 tons 7 cwt.; Harbinger 10 tons 6 cwt.; Ochil Queen 10 tons 2 cwt.; Sutton's Abundance 9 tons 11 cwt.; Queen Mary 9 tons 3 cwt.; Bishop 8 tons 18 cwt.; Culdees Castle 6 tons 9 cwt. Two new varieties were included—Ochil Queen, a strong-growing sort of the British Queen type, and Bishop.

The yields of late varieties were:—Seedling 12 tons 17 cwt.; Economist 12 tons 0 cwt.; Up-to-Date 11 tons 15 cwt.; Ochil King 11 tons 12 cwt.; Summit 11 tons 10 cwt.; Legaston Don 11 tons 2 cwt.; Factor 11 tons 0 cwt.; Arran Chief 10 tons 18 cwt.; Iron Duke 10 tons 18 cwt.; Arran Hope 10 tons 15 cwt.; Imperial 10 tons 8 cwt.; Templar 9 tons 16 cwt.; Vitality 9 tons 13 cwt.; Baronet 9 tons 8 cwt.; Northern Star 9 tons 7 cwt.; Dalhousie 9 tons 5 cwt.; Golden Wonder 7 tons 18 cwt.; What's Wanted 7 tons 12 cwt. Three new varieties were tested—Seedling, Economist and Ochil King.

Potato Experiments (*Dorset C. C. Educ. Com., Agric. Lft. No. 2*).—The soil was a fairly stiff sandy loam on the Reading Beds formation in Dorset. The conclusions are drawn from the 1915 trials that on similar soils in the county the varieties which may be grown with success are:—Sir John Llewellyn and Eclipse (earlies); Pioncer Queen, Colleen, Great Scot, British Queen, Culdees Castle and Epicure (second earlies); and Conquering Hero, Arran Chief, Lochar, Table Talk, King Edward VII., Balmoral Castle, Up-to-Date, Clarke's Maincrop, Dalhousie Seedling and Duchess of Cornwall (maincrop varieties).

Sprouted seed produced a larger and more profitable crop than unsprouted seed.

As regards change of seed it is recommended that at least half the stock should be changed every season.

Spraying with Bordeaux mixture against disease was found beneficial and profitable.

More saleable potatoes were produced at a less cost from "earthered" than from "unearthed" plants.

The best distances to plant were found to be from 24 to 28 in. between the rows and from 12 to 16 in. between the sets for maincrop varieties.

Varieties of Potatoes (*Midland Agric. and Dairy Coll., Rept. on Field Trials, 1915*).—A large number of varieties were tested, comprising early varieties lifted when green, early varieties allowed to ripen off, second early varieties, main-crop varieties and late varieties. Remarks on the yields and descriptive notes are given.

Ripe v. Unripe Seed Potatoes (*Midland Agric. and Dairy Coll., Rept. on Field Trials, 1915*).—The seed was the King Edward variety and was planted on a light loam, following oats. Unripe seed gave 10*1*² tons of ware and 1*1*² tons of seed per acre, while ripe seed gave 4*1*² tons of ware and 16 cwt. of seed per acre.

The results of this trial in 1914 and 1915 conclusively confirm the generally accepted view that immature seed potatoes are best. Potatoes for seed purposes should therefore be raised when the tops have withered, but are still green, *i.e.*, about a month before they are dead ripe.

Ripe v. Immature Seed of Potatoes (*Jour. Dept. Agric. Victoria, June, 1915*).—In a test of ripe and immature seed for planting, whether whole or cut, the following results were obtained:—Ripe seed, whole, 4 tons; ripe seed, cut, $1\frac{3}{4}$ tons; immature seed, whole, $5\frac{1}{2}$ tons; immature seed, cut, $4\frac{1}{2}$ tons per acre. At a second centre the increase due to immature compared with ripe seed was 2 tons 6 cwt. per acre.

Varieties of Spring Wheats (*Midland Agric. and Dairy Coll., Rept. on Field Trials, 1915*).—On a light gravelly loam after roots, 3 bush. per acre of seed of four varieties of spring wheats were sown on 5th March. The yields of saleable grain per acre in qr. (of 504 lb.) were:—Dreadnought $4\frac{1}{2}$, Red Marvel $4\frac{1}{2}$, Sensation 4, Marquis 3. Marquis came into ear and also ripened fully a fortnight before Red Marvel or Dreadnought. Sensation was distinctly the slowest in growth. It is concluded that, in the Midlands, Sensation should be sown not later than the third week in February, Dreadnought up to the first week in March, Red Marvel a week later, and Marquis up to the beginning of April.

Varieties of Oats (*Midland Agric. and Dairy Coll., Rept. on Field Trials, 1915*).—The following yields of saleable grain per acre were obtained (qr. of 336 lb.):—Victory, $7\frac{1}{4}$, Wideawake $7\frac{1}{2}$, Crown $7\frac{1}{4}$, Abundance 7, Beseler's Prolific 7, Scottish Chieftain $6\frac{1}{4}$, Golden Rain 6, Record 6, Triumph White $5\frac{1}{4}$, Yielder $5\frac{1}{4}$, Giant Eliza 5, Leader $4\frac{1}{2}$. Leader, Yielder and Record are evidently more suitable for good, rich soils than for the light gravelly loam on which these experiments took place.

Varieties of Oats (*West of Scot. Agric. Coll., Bull. 71*).—These experiments were carried out during the five years 1907-11. The following average yields were obtained, per acre:—

No. of Expts.	Variety.	Grain, Straw		No. of Expts.	Variety.	Grain, Straw	
		lb.	cwt.			lb.	cwt.
84	Beseler's Prolific	2,631	39	65	Golden Rain ..	2,317	33
93	Wideawake ..	2,570	38	109	Potato ..	2,309	44
37	Awnless Probstei	2,550	41	42	Twentieth ..		
108	Mounted Police	2,542	39		Century ..	2,286	34
68	Lincoln ..	2,499	40	110	Sandy ..	2,279	46
70	Waverley ..	2,485	37	52	Thousand Dollar ..	2,270	38
44	Storm King ..	2,429	36	23	Siberian ..	2,208	37
65	New Abundance ..	2,380	36	23	Danish Island ..	2,186	37
69	Viking ..	2,373	37	23	Bavarian ..	2,063	38
95	Banner ..	2,349	38	20	White Giant ..	2,048	37

As regards harvest, the early varieties were Storm King, New Abundance, Golden Rain, Twentieth Century, Viking, Danish Island, White Giant; the intermediate varieties were Waverley, Beseler's Prolific, Thousand Dollar, Mounted Police, Lincoln, Banner, Bavarian; the late varieties were Potato, Sandy, Wideawake, Awnless Probstei.

As regards soil, Beseler's Prolific, Wideawake and Mounted Police are stated to do well on nearly any type of soil, though Wideawake

does relatively better than the other two on poor soils. Lincoln gives a good return on heavy to medium soils, while Bumper and Waverley give relatively better returns on the lighter classes of soil. Viking does well on good soil and in good seasons, but suffers more than the three first-mentioned under adverse conditions; New Abundance is similar to Viking. Thousand Dollar is not recommended.

Varieties of Mangolds (*Midland Agric. and Dairy Coll. Rept. on Field Trials, 1915*).—The results of mangold trials carried out for several seasons are summarised as follows: *Golden Tankard* has proved an uncertain cropper; it is the best keeper and has a high feeding value; it does best when sown early on rich, deep soil with a good surface tilth. *Mammoth Long Red* has cropped well and the percentage of dry matter has been practically equal to that of *Golden Tankard*. *Yellow Intermediate* and *Lion Intermediate* are more certain croppers than *Golden Tankard*, especially on light soils; *Lion* has produced rather heavier crops, but is one of the poorest in percentage of dry matter. *Red Intermediate* has given the same yields as *Yellow Intermediate*, but its percentage of dry matter has always been the lowest of all. *Golden Gatepost* has apparently two strains, both of which are superior to *Yellow* and *Red Intermediate* in quality and beat *Golden Tankard* as croppers, and are well fitted for growing on medium and lighter soils for late use in place of *Tankards*. *Yellow Globe* has been the best and surest cropper, especially under unfavourable conditions of soil and season.

Manuring of Mangolds (*Midland Agric. and Dairy Coll. Rept. on Field Trials, 1915*).—The soil was a clay loam previously cropped with wheat.

Granular nitrolim (1½ cwt. per acre) gave 4½ tons per acre extra yield above that of sulphate of ammonia (1 cwt. per acre). The soil was lacking in lime, and it is confidently stated that on such a soil granular nitrolim is superior to sulphate of ammonia for mangolds.

While basic slag alone proved superior to superphosphate alone, a mixture of the two gave by far the best crop.

The addition of 3 cwt. salt to the manurial dressing (potash supplied by 1 cwt. muriate of potash) increased the yield by 3 tons; 4 cwt. kainit proved much better than 1 cwt. muriate of potash *plus* 3 cwt. salt.

Top dressing at the end of June with 1 cwt. nitrate of soda or 1½ cwt. nitrate of lime or 1 cwt. granular nitrolim proved very profitable. The two nitrates were best and of practically equal value; the granular nitrolim was not so good. Where the latter was applied on a *ctt* mangold leaves it burned them severely; the nitrate had no such effect.

A top dressing of 1 cwt. of salt along with the top dressings previously mentioned proved very profitable, the increases (except with nitrate of lime) being much larger on heavy soil than on light soil.

FEEDING STUFFS AND DAIRYING.

Bran and Dried Brewers' Grains (*Cockle Park Expt. Sta. Bull. No. 23*).—Bran and dried brewers' grains (separately) were compared with Bombay cotton cake and soya cake (together) as concentrated foods for cattle and sheep, the same amounts of digestible food constituents being supplied in each case.

The results are taken to show that provided the proper amounts of feeding constituents are fed, and the foods are of good quality, there

is little difference in the feeding values of the same amounts of the different foods fed in the trials. The choice of concentrated food is therefore dependent on price.

Wintering of Stisks (*Cockle Park Expt. Sta., Bull. No. 23*).—Trials were conducted in the winters of 1913-14 and 1914-15 to compare indoor and outdoor wintering of stisks; 22 blue-grey calves and 2 shorthorn and Aberdeen-Angus cross calves were used in the first trial, and 18 blue-grey calves in the second trial.

The rations used were, per 500 lb. live-weight per day (containing the same amounts of nutrients):—

1913-14.		
I.	II.	III.
(12 animals out-wintered.)	(6 animals in-wintered.)	(6 animals in-wintered.)
8 lb. meadow hay.	25 lb. swedes.	33½ lb. yellow turnips.
1 " soya cake.	6 " meadow hay.	6 " meadow hay.
1 " Bombay cotton cake.	1½ " soya cake.	1½ " soya cake.
1 " maize meal.		

1914-15.		
I.	II.	
(12 animals out-wintered.)	(6 animals in-wintered.)	
10½ lb. meadow hay.	35 lb. yellow turnips.	
1 " soya cake.	7 " meadow hay.	
1½ " bran.	1½ " soya cake.	
1 " Bombay cotton cake.		

The out-wintered lots had the use of a shelter shed open to the south; the in-wintered lots were housed and fed in boxes at night and were turned out to pasture during the day.

In 1913-14 the 3 lots made practically identical live-weight gains of 6½ lb. per head per week, but at the end of March a slightly higher value was put by practical valuers on those wintered outside, as they had better coats of hair, and were more promising as grazing cattle. The cost of food was slightly less for those out-wintered. Incidentally, it was shown that, provided equal amounts of dry matter are fed, swedes and yellow turnips can be substituted for each other.

In 1914-15 those out-wintered gained 4 lb. per head per week live-weight, and those in-wintered 4·7 lb. The gain per head from the out-wintered lot was 11s. 10d., and from the in-wintered lot 20s. 9d.

It has now been demonstrated at Cockle Park for 4 winters in succession that young cattle from 6 to 12 months old can be wintered with excellent results on pasture, if they have access to a shelter shed, and receive suitable additional food. At the end of the winter those wintered outside have better coats of hair, and will command higher prices as grazing cattle. They also possess the great advantage of practical freedom from tuberculosis (see also this *Journal* for April, 1915, p. 71, and December, 1914, p. 812).

Winter Feeding of Bullocks (*Brandon Expt. Farm, Canada; "Farmer's Advocate," Winnipeg, 16th June, 1915*).—The bullocks were divided into four lots, two of which were wintered in a stable, while two were kept outside with only an open shed for shelter. All four lots received the same grain ration. One of the lots wintered indoors received straw and maize silage as fodder, while the other had mixed hay. One of the outside lots was given lucerne as fodder, the other receiving mixed hay. The animals were sold in the spring after 191

days' feeding. The results of the experiment were as follows, the figures showing the average per bullock :-

	Average gain in 191 days.	Average cost of food.	Average profit over cost of food.
	lb.	£ s. d.	£ s. d.
<i>Wintered indoors—</i>			
Lot I.—Mixed hay ..	362	7 14 4	1 11 9
“ II.—Straw and maize .. silage	319½	7 7 1	1 12 10
<i>Wintered outside—</i>			
Lot III.—Mixed hay ..	314	8 2 8	15 2
“ IV.—Lucerne	329	8 5 0	19 11

It will be seen that, of the bullocks fed on mixed hay, those wintered indoors made a considerably higher gain and yielded more than double the profit obtained from the outdoor lot. Under exactly similar conditions straw and maize silage proved more profitable as fodder than mixed hay, though producing a smaller gain in weight; lucerne gave a rather higher profit than mixed hay.

Pig Feeding with Uncooked Meals (*Cockle Park Exp. Sta., Bull. 23*).—These trials were conducted to ascertain whether it was possible to feed pigs profitably on meals *alone* in Northumberland.

In both 1913 and 1914 four young pigs were bought at 8 weeks old, and the trial was concluded in each year when they were 32 weeks old. In the first of these 6 months the pigs were allowed, in 1913, 1½ pts. of milk per head daily, and in 1914, ½ gal. of skim milk daily; throughout the whole period the meal, otherwise forming the sole food, consisted of maize and gram, crushed and fed in the form of a cold “crowdy” (mixture of meal and water).

The pigs in 1913 cost, on the average, £1 5s. to purchase, and the cost of the food for the period was £1 8s. 3d., making a total of £2 13s. 3d. per head. The sale value of each pig at the end of the trial was £3 14s. 5d., leaving £1 2s. 2d. as the gain per pig. Each pig consumed 389 lb. meal and made a gain of 135 lb. live-weight; neglecting the small amount of the milk fed, about 3 lb. meal produced 1 lb. live-weight increase.

In 1914 the pigs cost £8s. each and sold for £5 10s. each. The food cost £2 13s. 8d. for the 24 weeks, leaving £1 8s. 4d. as the gain per pig. The pigs each consumed 830 lb. meal and made a gain of 215 lb. so that, again neglecting the milk fed, about 3½ lb. meal produced 1 lb. live-weight increase.

The amount of food fed in the first month was 8½ lb. maize and 40 lb. gram per 1,000 lb. live-weight per day, gradually changing by the sixth month to 16½ lb. and 18½ lb., respectively, in 1913, and to 18¾ lb. and 20½ lb. in the 1914 experiment.

Feeding of Straw to Pigs (*Building's Landw. Ztg.*, 1st and 15th December, 1915).—There has been some discussion in Germany as to whether grinding straw increases the digestibility of the fibre. In these experiments carried out with 3-months-old pigs from February to August, 1915, it was found that even a partial substitution of finely ground straw for fine wheat bran (increased from approximately 2 lb. to 4 lb. over the period) in the ration seriously interfered with successful

fattening and the utilisation of the total ration; when the straw "meal" completely replaced the bran, the live-weight was reduced practically to one-half. With no straw, 1 lb. live-weight increase was obtained from 1·6 lb. protein and 9·9 lb. starch equivalent; with half straw in place of half bran, 2·1 lb. protein and 15·6 lb. starch equivalent; with straw completely replacing bran, 2·1 lb. protein and 20·2 lb. starch equivalent.

Feeding Value of Grasses (*Die Landw. Versuchs-Stat., LXXXVII., 4 & 5; P. Honcamp and others*).—The following results were obtained from digestibility experiments on sheep. The figures are reckoned as percentages of dry matter + 15 per cent. of water.

Grass,	"High" Moor Soil, 1911.		"Mineral" Soil, 1912.		Marsh Soil, 1912.		Marsh Soil, 1913.	
	Dig. Protein. Equiv.	Starch Equiv.	Dig. Protein. Equiv.	Starch Equiv.	Dig. Protein. Equiv.	Starch Equiv.	Dig. Protein. Equiv.	Starch Equiv.
Lolium perenne	4·10	39·9	—	—	2·02	25·9	1·37	28·4
" italicum	2·20	40·8	—	—	2·05	29·8	—	—
Dactylis glomerata	3·34	35·6	—	—	2·57	27·4	1·67	23·6
Phleum pratense	2·28	40·8	{ 0·71	30·81	3·02	27·5	0·97	27·2
Poa pratensis	4·58	36·0	—	—	—	—	—	—
" trivialis	5·13	40·9	—	—	—	—	—	—
Festuca pratensis	3·68	37·9	—	—	—	—	2·09	27·7
" rubra	3·11	38·6	—	—	5·46	34·2	1·28	22·1
Agrostis vulgaris	—	—	1·73	41·0	—	—	—	—
Average ..	3·56	39·1	1·22	35·3	3·22	28·9	1·46	26·4

Former experiments carried out by the investigators had given the following figures for starch equivalent (on dry matter + 15 per cent. water):—"High" moor hay, 36·06; clover hay, 32·54; marsh hay, 30·37; "low" moor hay, 28·59. The conclusion is drawn that "high" moor, if properly cultivated, yields a fodder quite equal, and even surpassing, in feeding value that on "mineral" or marsh soils.

Hempseed Cake for Dairy Cows (*The Analyst*, October, 1915; *H. T. Cranfield and M. G. D. Taylor*).—The composition and quality of milk and butter produced by feeding hempseed cake was quite equal to that obtained by feeding linseed cake.

The effect of removing cows from poor pasture on to a well-balanced ration in the stall was shown very strikingly by the data obtained. It caused a large fall in the percentage of fat, a considerable rise in the Reichert-Meissl, Kirschner and Polenské values, and a fall in the refractometer figure.

Pigmentation of Bacon (*Jour. Agric. Sci.*, Vol. VII., Pt. 2; *K. J. J. Mackenzie, M.A., and F. H. A. Marshall, D.Sc.*).—Former investigation having shown that no mammary pigment could be detected in the old sows examined, the present test sought to establish whether such pigment had previously been present in the sows, and had been destroyed or removed during the periods of glandular activity. Four sows of coloured varieties were taken, three being Large Blacks, and one a Berkshire. All four animals were operated upon on the same date, and pigment was found to be present in the mammary glands in each case. All the sows subsequently had two litters, and later on they were killed on the same day, when it was found that in three

cases the pigment had entirely disappeared, and in the fourth case only a very slight trace remained.

These experiments are held to prove very clearly that pigment may be no longer present in sows which have been bred from. While the precise period or periods at which the pigment disappears is unknown, there is a strong presumption that this takes place either during the progress of lactation or in the period of pregnancy when the mammary glands are being built up preparatory to the secretion of milk.

Effect of Time of Milking on Quantity and Quality of Milk (*Durham C. C., Offerton Bull. No. 5; F. P. Walker, M.Sc.*).—This experiment lasted over two periods of 6 weeks each, and the cows were divided into two lots. During the first period Lot I. was milked at 6 a.m. and 6 p.m., and Lot II. at 6 a.m. and 4 p.m., while during the second period the times of milking of the two lots were reversed.

The total amount of milk did not appear to be influenced by the equal or unequal periods of milking, but, as is usually the case, uneven periods of milking resulted in a reduction in the butter fat content of the morning milk, while an even interval tended to obviate this. The cows which were milked at even periods gave more milk in the evening than in the morning, though the evening's milk was slightly poorer in quality than the morning's.

In a note on the above experiment it is stated that the results tend to confirm a theory previously formulated, namely, that if cows are milked at 6 a.m. and 6 p.m. the evening's milk will be 0.2 per cent. poorer in fat than the morning's, and that for every half hour earlier the evening's milk is obtained it gains 0.25 per cent. over the morning's fat content, so that milk obtained at 3.30 p.m. is 1.05 per cent. richer than that got at 6 a.m.

Comparison of Milking Twice or Three Times a Day (*Durham C. C., Offerton Bull. No. 5; F. P. Walker, M.Sc.*).—One lot of cows were milked at 6 a.m. and 6 p.m., and the other lot at 5 a.m., 12.30 p.m. and 6 p.m.; after 6 weeks the two lots were interchanged for a further 6 weeks. The results showed no advantage in milking three times daily, and the extra labour would be considerable. Moreover, the milk in the morning from cows milked thrice daily was often of a poor character, and fell below the 3 per cent. limit.

Effect of Increasing the Amount of Calcium Phosphates in the Rations of Cows on the Composition of the Milk (*Paper read at the British Association Meeting, 1915; A. Lauder, D.Sc., and T. W. Fagan, M.A.*).—The general opinion of previous workers that the composition of the mineral matter in the milk could not be readily affected by adding mineral matter to the food was confirmed by this experiment, in which calcium phosphate was added to the rations for five weeks in amount rising to eight ounces per head per day. There was no increase in the amount of phosphoric acid, the percentages of fat, ash and "solids not fat" were not affected, and no definite effect on the yield was observed.

Effect on Yield and Quality of Milk of Feeding Phosphate to Cows (*Durham C. C., Offerton Bull. No. 5; F. P. Walker, M.Sc.*).—Pre-cipitated bone ash, containing about 70 per cent. of phosphate of

lime, was fed to milking cows on pasture at the rate of 1 oz. per head per day, the cows receiving also a concentrated ration. The phosphate seemed to have very little effect on the quantity or quality of milk, and did not cause a stimulation of the nervous system of the cows, such as had been thought possible. The only result from feeding the bone ash seemed to be a slight increase in carcass weight.

POULTRY.

Egg-Laying Competitions at Harper Adams College (*Poultry Competition Monthly*, issued by the College, Vol. I., No. 3).—The third period of the 12 months' and 2 years' laying competitions terminated on 25th December. During the third period eggs reached the maximum price, viz., 2s. 11d. per doz. in the week ending 8th December. The number of eggs laid and their value in each section of the competition for the 12 weeks are as follows:—

Average per Pen of Six Birds (including unrecorded eggs).	12 Months' Competition.		Two Years' Competition.	
	Eggs.	Value.	Eggs.	Value.
Section I. (Leghorns)	123.3	2s. 5	106.8	20 10
" II. (Wyandottes)	131.2	2s. 4	119.4	23 3 $\frac{1}{2}$
" III. (Reeks, Orpingtons and Rhode Island Reds)	105.0	2s. 3 $\frac{1}{2}$	112.4	22 4
" IV. (Sussex)	—	—	95.75	18 7
" VI. (Farmers' and Small Helders' Section)	110.4	2s. 1 $\frac{1}{2}$	—	—
All the birds	122.3	2s. 5	111.2	21 10

Section V. was intended for "any other non-setting breed," but no entries have been received.

Tumours in Fowls (*Jour. Agric. Research* [U.S.A.] 29th November, 1915; *Maynie R. Curtis*).—The following conclusions are based on an examination of data collected during 8 years' autopsy work at the Maine Agricultural Experiment Station:—

Nearly 9 per cent. of the birds had tumours, there being no real difference in this respect between birds which died from natural causes and apparently normal birds which were killed.

The occurrence of tumours increased with age; only 7 per cent. of the birds under 2 $\frac{1}{2}$ years had tumours, while neoplasms were present in 19 per cent. of those over that age.

In birds which died from natural causes, the tumours were directly or indirectly the probable cause of death in from one-third to one-half the cases.

Hypertrophied liver, spleen, or kidney tended to be associated with the presence of tumours in other organs; death often resulted from internal hemorrhage from the tumour, the underlying tissue, or the hypertrophied liver and spleen.

The organs most frequently affected in the females were the genital organs; in most cases the tumours were confined to one organ.

NOTES ON AGRICULTURAL CO-OPERATION.

CO-OPERATION between farmers for the disposal of their milk may lead to improvement in the purity and regularity of the supplies, to a better price being obtained by the producer, and to the removal of difficulties in connection with the disposal of surplus milk. Co-operation should prove of advantage not only to the farmers themselves, but also, from the point of view of the improvement of purity, to the general public as consumers.

Purity.—The purity of milk as it reaches the consumer is likely to be improved by the organisation of the producers, since it is to be expected that the milk will receive more effective treatment for the removal of impurities at the common collecting centre than on individual farms; and, further, clean methods on the farm are much more likely to be adopted under a co-operative system, since members must conform to the society's regulations.

Disposal of Surplus Milk.—Co-operation should facilitate the disposal of the surplus milk, which could be converted into cheese, cream or other milk products at the collecting depot, and it has been found profitable in some cases to establish a central depot, solely, or almost solely, for the disposal of surplus milk.

Some societies, for example, make cheese with great success. One society collects cream and makes it into butter at a central creamery. A Welsh society has adopted a system of butter blending as an alternative to making butter; the farmers make the butter themselves and send it, unsalted, to the premises of the society, where it is blended by an up-to-date plant. Another society converts its surplus milk into cream and separated dried milk powder.

The central depot is much more likely to be able to secure efficient marketing than the individual farmers. Among other advantages the produce could be graded and standardised, and public attention could be attracted and its confidence retained by efficient advertising and the use of names and brands.

The Collecting Depot.—The first step to be taken by dairy farmers who have agreed to combine to dispose of their milk, is the establishment, preferably at or near a railway station, of a milk *collecting depot*, equipped with a refrigerating plant and cold store, as well as with the necessary plant and utensils for the manufacture of cheese, butter, and other forms of milk products. The provision of an ample supply of pure cold water is essential for refrigerating purposes. The milk of the district would be brought to this depot, and, after being tested and thoroughly refrigerated, cleansed and pasteurised, it would be dispatched by rail or motor to the retail depots or shops in the large centres of population, as well as to public institutions, hotels and restaurants.

Creameries or depots may cost from £1,500 to £10,000 to erect and equip, but no hard and fast rules can be laid down, either as regards the plan on which the depot is to be erected and equipped or the formation of a society, since due allowance will have to be made for the varying conditions in different districts. In one centre the primary object may be a milk depot for the treatment and distribution of milk, with a plant sufficient to deal with the manufacture of the surplus into cheese; at another centre the business may be partly a milk trade

and partly the manufacture of milk products; while in some districts milk selling will be quite out of the question, and cheese-making in summer and butter-making in winter will be advisable.

Capital and Business Management Necessary.—It must be borne in mind that a society should not commence to trade until adequate capital has been provided to start and carry on its business, and that a society cannot hope to succeed unless it is controlled by business men and is in a position to employ a competent manager and staff.

The capital of some of the largest societies in this country ranges from about £2,500 upwards, and the turnover from about £20,000 upwards.

Some of these societies have adopted a principle which it is very desirable should be extended, not only in co-operative milk selling but in other forms of agricultural co-operation, viz., *trading with industrial co-operative societies*. As an example, one society, in addition to trading with ordinary retailers, and disposing of nearly 1,000 gallons daily to public institutions, sells about 2,000 gallons of milk daily to an industrial co-operative society.

By-laws.—To carry out a scheme for the organisation of the milk supply on a proper basis, by-laws would have to be drawn up, regulating the conditions under which the milk should be produced and dealt with before it reaches the depot. Many of the co-operative dairy societies affiliated to the Agricultural Organisation Society have drawn up such by-laws. The societies are registered under the Industrial and Provident Societies Act, 1893, and have in most cases adopted the model rules of the Agricultural Organisation Society. Model rules for co-operative dairy societies may be obtained from the Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, S.W., who will be pleased also to supply further information as to co-operation in the dairying industry, and to assist with advice in the formation of co-operative societies.

OFFICIAL NOTICES AND CIRCULARS.

No outbreak of foot-and-mouth disease has occurred on any premises in Great Britain since that confirmed on the 11th February

at the County Asylum, Wells, Somerset.

Foot-and-Mouth mentioned in last month's *Journal*. The **Disease.** district scheduled in connection with that

outbreak, to which restrictions on the movement of animals were applied, was gradually reduced and all the restrictions were withdrawn by an Order of the Board which came into operation on the 13th March.

In connection with the tracing of certain calves sold from premises at the Wells County Asylum, it was found that some of them had been moved to the Midlands and exposed for sale in certain markets in Warwickshire and Oxfordshire. It was considered advisable, therefore, as a precautionary measure, to make an Order prohibiting, for the time being, the exposure of animals for public sale or exhibition within an area surrounding those markets, and also prohibiting the movement of animals out of that area. This Order was made on the 14th February. The calves concerned having been traced and no foot-and-mouth disease having been found either in them or any other animals in the area scheduled, the Order was revoked on the 22nd February.

The attention of the President of the Board of Agriculture and Fisheries has been drawn to the possibility of farmers and shepherds.

Carrying of Lights at Night on Farms. By carrying lights at night when attending stock, rendering themselves liable to prosecution under the Lighting Regulations at present in force.

Lord Selborne has been in communication with the Home Office, and is advised that the sole requirement is that such lights must be properly screened.

It is understood that a lamp of a special pattern has been manufactured at the suggestion of the National Farmers' Union in Lincolnshire, but the use of any particular pattern of lamp is not necessary.

One simple arrangement which has been adopted is to place the light in a biscuit tin with straight sides.

THE following Circular Letter, dated 18th February, 1916, regarding the purchase and use of sulphate of ammonia by farmers, has been addressed to the secretaries of County War

Sulphate of Ammonia: Purchase and Use by Farmers. Agricultural Committees:—

SIR.—I am directed by the President of the Board of Agriculture and Fisheries to refer to the notice recently issued as to the suspension of licences for the export of Sulphate of Ammonia, and to enclose copies of a notice* and leaflet† which have been issued, and to which he hopes you will give the widest publicity possible. Will you let me know how many copies could be distributed with advantage in your district?

In order that your Committee may be in possession of full information on this matter, I am further instructed to enclose extracts from speeches‡ made by Lord Selborne and Mr. Acland to a deputation received at the Board's offices on the 2nd instant from the Central Chamber of Agriculture with reference to the position as regards Sulphate of Ammonia. It will be seen that the President desires to encourage, to as great an extent as possible, the use of sulphate of ammonia by farmers this spring, and to urge them to purchase their supplies without delay. Lord Selborne hopes, therefore, that War Agricultural Committees will at once take such steps as they may deem most effective to support the efforts he is making in this direction.

I am also to forward copies of lists§ of makers of sulphate of ammonia to whom the farmers in your district might apply for such supplies as they require. As, however, makers are sometimes not very willing to deal with small orders, and do not usually give credit, it has been considered desirable to add to the list of makers the names of certain dealers who are stated by the Sulphate of Ammonia Association to be sellers of sulphate of ammonia. The Association inform the Board that the price asked by these merchants should not exceed £16 15s. per ton, including bags, free on rail, but the Board have on this occasion not been able to make any arrangement as to the terms, which must be a matter for negotiation in each case.

Lord Selborne desires to lay stress on the importance of urging farmers to place their orders without delay. Owing to the fact that

* See *Journal*, February, 1916, p. 1180.

† See p. 1297.

‡ Printed below.

§ Not here printed.

sulphate of ammonia is an important by-product in connection with the manufacture of certain materials required by the Ministry of Munitions, it will not be possible to continue the suspension of licences for export unless it can be proved that there is an effective demand for sulphate of ammonia by farmers sufficient to prevent any interference with the production of explosive materials.

I am, &c.,

SYDNEY OLIVIER,

Secretary.

ENCLOSURE TO ABOVE LETTER.

Extracts from Speeches made by the President and the Parliamentary Secretary of the Board of Agriculture and Fisheries to a Deputation from the Central Chamber of Agriculture on the 2nd February, 1916.

The President, in the course of his speech, said :—

I want first of all to come to the question of sulphate of ammonia. What you have said to-day is practically this, that the increase in the price of sulphate of ammonia since the war is justified by the increase in the cost of production; but that the price before the war was not justified, and the Government ought to intervene to fix a price. I am not prepared without examination to accept the statement which has been made as to the pre-war cost of producing sulphate of ammonia. You must remember there are a great many producers of sulphate of ammonia, the gas works, the shale oil works, the coke ovens and the Mond process, and while I am not in a position to say that no producer of sulphate of ammonia could produce at (say) £5 per ton, I am perfectly certain that they could not all do so, and that in most cases such a price would cause the producer to go out of business.

The Government cannot fix prices except by Act of Parliament, and no Act has been passed by Parliament which would empower us to fix the price which should be charged to farmers for sulphate of ammonia. The moment it was proposed to get an Act of Parliament to do that, you would have people demanding a fixed price for all your products.

I have been very strongly pressed by influential interests in this country to interfere with the prices which farmers are getting for their produce, but I have resolutely refused. It is impossible for me to consider fixing maximum prices for what the farmer uses if I am to maintain the position that maximum prices are not to be fixed for what he produces.

The sale of 300,000 tons of sulphate of ammonia abroad at £17 per ton is a real contribution towards the solving of the difficulties of financing the war and steadyng the foreign exchange; therefore, it was no easy matter, with those big financial considerations against us, to have stopped the export of sulphate of ammonia. I do not hold out any hope of fixing a maximum price for sulphate of ammonia, but I hope the steps we have taken will automatically reduce the price to a certain extent.

The comparative manurial values of the different fertilisers show that sulphate of ammonia at £16 10s. a ton is of the same value as nitrate of soda at £13 10s. a ton, and very few farmers at the present moment would hesitate to buy nitrate of soda at £13 10s. a ton if they had a chance.

The Parliamentary Secretary to the Board of Agriculture and Fisheries, in the course of his remarks, said :—

As you are all aware, we made in the autumn a special arrangement with the Sulphate of Ammonia Association whereby they should sell

under certain conditions sulphate for use as an autumn dressing in November and December at £14 10s. a ton. That arrangement had in it the element of a bargain. We were pushing the use of sulphate of ammonia, which we believe to be a thoroughly sound thing in certain parts of England, Wales and Scotland, though not by any means universally, and, in return for that, the makers agreed to drop their price below that which they could have obtained in other markets. This arrangement could not be continued into the spring, as we could not insist on makers selling at an especially low price for the ordinary normal supplies which agriculturists take in the ordinary course of their business. All through the autumn we have been urged by farmers and representatives of farmers to prohibit the export of sulphate of ammonia, but we did not do this as there did not seem to be any certainty that we could get anything like the total production of that fertiliser taken up and actually used by the agricultural community.

Now that the time of the year has arrived when it is extremely desirable in the interests of the nation that sulphate of ammonia should be bought and used in large quantities, the question of the prohibition of export has presented itself in a different form from what it did in the autumn, and it has recently been decided absolutely to suspend the issue of licences for export.

The Government, in the interest of food production, is responsible, and has certain powers to secure, that there shall be ample supplies. They are not in any similar way responsible, and they have not in any similar way the power, to control the price at which those supplies shall be available.

We must realise that the prohibition of export which is now in operation **cannot last** for ever. Four times as much sulphate is normally produced in this country as is normally consumed in this country by farmers and for commercial purposes. In many cases sulphate is produced as a by-product of industries, of which another product, if not the main product, is one or other of the materials which are extremely necessary for munition purposes. Immediately these makers find stock accumulating on their hands (which in the ordinary way they would have exported) they will claim that the suspension of exports is affecting their output of materials required for munitions. Clearly we cannot go on indefinitely refusing the demands that export should again be allowed, therefore we want farmers to realise that they ought to take advantage of the present prohibition of export to buy as much of this fertiliser as they can possibly afford to buy.

One of the difficulties is that the parts of the country where sulphate is mainly used are not parts of the country where sulphate is mainly produced; and the more farmers and merchants can fill their demands and spread them into the districts which do not normally supply the farmers, the less will be the pressure upon us to relieve the accumulations by again allowing export. The local gas works may possibly be sold out, but the farmer or dealer will find that there are ample supplies 50, 80 or 100 miles away in the industrial districts. Although that means extra railway transport it will be thoroughly worth while for the farmer or merchant to incur that little extra expense of transport in order to get the sulphate, and relieve the pressure on the supplies.

The position is a balance between two forces; the force of the farmer consuming the sulphate, and the force of those interested in munitions in preventing accumulations which are not made use of.

We wish, therefore, to point out the great importance in the farmers' interest and in the national interest, of using as much sulphate of ammonia as they can in the coming months, and (if necessary) obtaining it even from persons who do not normally supply it for agricultural purposes.

THE following Circular Letter, dated 23rd February, 1916, has been addressed by the Board to War Agricultural Committees in England and Wales:—

Employment of Women on the Land. SIR,—1. The President of the Board of Agriculture and Fisheries desires particularly to invite the further co-operation of your Committee in improving the efficiency of the arrangements which have been set on foot to encourage the employment of women on the land.

2. This matter was dealt with in the Board's Circular Letter of the 29th November last,* and at the conference held at the Middlesex Guildhall on the 31st December last, a report of which has been sent to you, but in view of the great and growing importance of maintaining and increasing, if possible, the home production of food, Lord Selborne has decided to make a further appeal to you on the subject.

3. It is obvious that the cultivation of the land and the production of food depend upon the sufficient supply of labour. Lord Selborne has made special efforts to secure the retention on the land of farmers and of the principal classes of their skilled employees, but more men are needed for the army, and the ranks of the agricultural classes must contribute to the supply. The shortage of labour on the farms is already serious in many parts of the country, but farmers must face the fact that the situation is bound to become more difficult, and that the shortage will increase, and will be felt far more severely next spring and summer than was the case last year. In these circumstances Lord Selborne hopes that the War Agricultural Committees will take pains to make the position clear to farmers throughout the country, and will use their influence to induce them to meet the deficiency of labour by making use of the services of women, paying them reasonable wages and assisting in training them for agricultural work. Women have shown that they are fully capable of performing satisfactorily many forms of farm work, and Lord Selborne is satisfied that the shortage of labour can best be met by enlisting their aid.

4. It is not sufficient, however, that the farmers should be prepared to employ women, though this is the first essential. An appeal must also be made to the women to offer their services, and this appeal must be made on national and patriotic grounds. It must be pointed out that the production of food is essentially war work. A woman who works on a farm is doing just as valuable service to the country as if she were employed in a munitions factory or helping in a hospital, and she is bearing her part of the national burden equally with her husband, her son or her brother in the trenches or on the sea.

5. Lord Selborne has therefore been taking steps for the purpose of organising as promptly as possible a national recruiting campaign for the enlistment of women in agricultural work. Some women will be found able to give their whole time to such work. Others, particularly the wives of the labourers living in the rural districts,

* See *Journal*, December, 1915 (p. 862).

may only be able to offer themselves for three or four afternoons a week. Some will require training; others who have had some experience of agricultural conditions will only require some preliminary supervision. But the services of all classes will be needed; and in order to reach all classes of women there must be in every county a Women's Farm Labour Committee, with local sub-committees working in concert with the War Agricultural Committee, but carrying on its campaign with its own staff and machinery.

6. Lord Selborne recognises that considerable progress has already been made in establishing the desired organisation, and he takes this opportunity to express his warm appreciation of the co-operation he has received from County War Agricultural Committees, and of the valuable work which has been done both by many women resident in country districts and by the organisers of women's work attached to the Labour Exchanges, in the establishment of women's organisations in many counties to deal with the question. Lord Selborne is glad to be able to say that the Board of Trade are increasing the number of their women organisers, and he hopes that this will make it the easier for the War Agricultural Committees throughout the country to continue to work in constant co-operation with these officers in all matters relating to women's labour, and that it will be possible to arrange for the woman organiser* for the district to be present at any meetings of your committee at which the question of women's labour on the land is likely to be discussed.

7. With the object of assisting in this work Lord Selborne has appointed Miss M. L. Talbot, Secretary of the Victoria League, to be a woman inspector of the Board of Agriculture, and she will be glad to attend and speak at any meetings to which she is invited.

8. When a Women's Farm Labour Committee for the county has been set up, it should appoint district committees or local representatives and village registrars with a view to undertaking a systematic canvas of the women of the county, and the formation of a register of those women who are willing to offer their services. This work has already been undertaken in some counties, but not in many. It is desirable that the work of the Women's Labour Committees should be kept in touch with that of the War Agricultural Committees, and it is suggested that the most convenient method of doing this is that the War Agricultural Committee should delegate to the Women's Farm Labour Committee all questions relating to women's work on the land, and that two or more members of each committee should be co-opted on the other committee.

9. A similar connection may be made between the District War Agricultural Committees and the Women's Farm Labour Sub-Committees.

10. The women's committees will arrange, where desirable, to hold meetings for the purpose of inviting and encouraging women to offer their services on the land. For such meetings, competent speakers will be required. The Women's Farm Labour Committee for the county will, no doubt, be able to supply speakers in many cases, but it has also been arranged that a panel of approved women speakers should be drawn up by the Board of Agriculture and Fisheries. If a

* Communications should be addressed to the Agricultural Organising Officer, c/o the Divisional Officer, at the addresses given at the end of this letter.

women's committee desires the services of one of these speakers, application should be made through the Agricultural Organising Officer at the Divisional Office of the Labour Exchanges.

11. The Board of Agriculture and Fisheries propose to issue leaflets, &c., on the subject of women's work on the land, suitable for distribution at meetings or otherwise, and I am to enclose copies of two reprints from the Board's *Journal*. Further copies will be supplied on application.

12. With regard to the expenses of the Women's Farm Labour Committees, I am to say that the Labour Exchanges Department of the Board of Trade are prepared to supply the committees with headed notepaper, franked envelopes, register forms, and posters for meetings, and that the Board of Agriculture and Fisheries are prepared to consider applications from them for small grants to defray the travelling expenses &c., of speakers at meetings organised by the committee. In addition, it will be open to a County War Agricultural Committee to make grants towards any other expenses of the women's committees out of the funds at their disposal, whether such expenses were included in the original estimate sent by them to the Board or not. If the grant made by the Board to any County War Agricultural Committee has been fully expended, or if grants which it might be desired to make to women's committees would cause the estimates of their expenditure which they have submitted to be exceeded, the Board will be prepared to consider an application for an additional grant, on receipt of a statement of the expenditure they have already incurred.

13. In recognition of the patriotic spirit of those women who undertake work on the land Lord Selborne proposes, in conjunction with the President of the Board of Trade, to grant a certificate, emblazoned with the Royal Arms in colours, to such women workers. These certificates will be issued to the County Women's Farm Labour Committees, who will be responsible for their distribution. It is also being considered whether an armlet should not be issued to women workers on the land.

14. Lord Selborne has also given consideration to the question of clothing suitable for women agricultural workers, and he has approved a costume consisting of a coat and short skirt of durable washing material, together with gaiters and stout boots. Samples of this costume will be supplied to the women's committees, through whom it will be possible for women workers to order them. The cost of the coat will be 10s. 6d., the skirt 5s., the boots 7s. and the gaiters 4s. It is suggested that farmers who employ women workers might help them in regard to their clothing by advancing the cost, and being gradually repaid, or that women's committees might raise funds locally for those who cannot afford to purchase the costume.

15. I am to add that Lord Selborne desires to commend to your committee the Women's National Land Service Corps, of 50, Upper Baker Street, London, W. The Duke of Marlborough is the President of the Corps, and Mrs. Roland Wilkins is the Chairman of the Committee. The Corps has been formed to assist the Women's Farm Labour Committees throughout the country, and to take part in the campaign for enlisting the services of women on the land, and Lord Selborne has secured for the Corps a Government grant proportionate to such sum as may be raised from voluntary contributions. The Corps proposes, in the first instance, to make a national appeal for the services of a

large number of women who will be prepared to act as forewomen in charge of gangs of women workers on the land, and to enrol them as members of the Women's Land Service Corps. Lord Selborne believes that an organisation of the kind is likely to appeal with some force to the women of the country, and he desires to say that it has his hearty approval and grateful support. He understands that the Corps proposes to send to your committee a statement of its aims and objects, and he hopes that your committee and the women's committees will make use of any assistance which the Corps can give in promoting the employment of women on the land or in supplying leaders for the women workers in any district or parish.

I am, &c.,

SYDNEY OLIVIER (*Secretary*).

Areas and Divisional Offices.

<i>Area.</i>	<i>Address of Divisional Office.</i>
1. LONDON AND SOUTH EASTERN DIVISION.	Martlett House, Bow Street, W.C.
London, Middlesex, Surrey, Sussex, Kent, Essex, Hertfordshire, Bedfordshire, Buckinghamshire, Oxfordshire, Berkshire, Huntingdonshire, Cambridgeshire, Norfolk, Suffolk.	
2. SOUTH WESTERN DIVISION.	Carlton House, Woodland Road, Bristol.
Cornwall, Devonshire, Somerset, Dorsetshire, Hampshire, Wiltshire, Gloucestershire.	
3. WEST MIDLANDS DIVISION.	Dalton House, Corporation Street, Birmingham.
Staffordshire, Shropshire, Warwickshire, Worcestershire, Herefordshire.	
4. YORKSHIRE AND EAST MIDLANDS DIVISION.	South Parade, Doncaster.
Northamptonshire, Rutland, Leicestershire, Lincolnshire, Nottinghamshire, Derbyshire, Yorkshire.	
5. NORTH WESTERN DIVISION.	Empire Hall, Museum Street, Warrington.
Cheshire, Lancashire.	
6. WELSH DIVISION.	Law Courts, Cathays Park, Cardiff.
Monmouthshire and all Welsh Counties.	
7. NORTHERN DIVISION.	Grassmarket, Edinburgh.
Cumberland, Westmorland, Durham, Northumberland.	

MISCELLANEOUS NOTES.

THE *Bulletin of Agricultural and Commercial Statistics* for February, 1916, issued by the International Institute of Agriculture, shows

the production of cereal crops during the past

Notes on Crop year. The countries for which it is possible

Prospects and Live to give an approximate estimate are as

Stock Abroad. follows:—In Europe—Hungary (proper), Den-

mark, Spain, France, Great Britain, Ireland,

Italy, Luxemburg, Norway, Netherlands, Rumania, Russia in Europe

(54 governments), Switzerland; in *America*—Canada, United States; in *Asia*—India, Japan, Russia in Asia (10 governments in 1915 and 9 governments in 1914); in *Africa*—Egypt, Tunis.

Wheat.—In the above-mentioned countries the total production in 1915 is estimated at 454,538,000 qr., against 371,283,000 qr. in 1914, or an increase of 22·4 per cent., while the area under cultivation was 7·3 per cent. greater.

Rye.—The total production in the specified countries, excluding Great Britain, India, Japan, Egypt, and Tunis, is estimated to amount to 137,370,000 qr. in 1915, against 119,395,000 qr. in 1914, or an increase of 15·1 per cent., while the area sown was practically identical in each of the two years under consideration.

Barley.—The production in the afore-mentioned countries, with the exception of India, is placed at 146,901,000 qr. in 1915, as compared with 125,102,000 qr. in 1914, the increase being equal to 17·4 per cent., but the area sown was smaller than in the preceding year by 1·7 per cent.

Oats.—The production in the above countries, exclusive of India and Egypt, is estimated to approximate to 404,472,000 qr. in 1915, or an increase of 25·6 per cent. compared with 1914, when the production amounted to 322,013,000 qr. The area sown was greater by 1·9 per cent.

Maize.—In Hungary, Spain, Italy, Rumania, Russia in Europe (54 governments), Switzerland, Canada, United States, Japan, and Russia in Asia (10 governments in 1915 and 9 governments in 1914), the total production is estimated at 417,290,000 qr. in 1915, against 371,930,000 qr. in 1914, an increase of 12·2 per cent., while the area sown showed an increase of 4·9 per cent.

Sowing of Winter Cereals.—The areas estimated to have been sown with winter wheat in 1915-16, compared with the areas sown during the corresponding period of 1914-15, expressed as percentages, are as follows:—Denmark 100, Spain 106, France 91, England and Wales 94, Switzerland 107, Canada 85, United States 89, India 95; with rye:—Denmark 100, Spain 95, France 89, Switzerland 105, United States 97; with barley:—Denmark 100, Spain 121, France 67, Switzerland 103; with oats:—Denmark 100, Spain 117, France 88.

Russia.—According to a report of the Central Statistical Committee, the production of the spring grain crops in 1915 in 56 governments and provinces of European Russia (the governments occupied by the enemy being excluded), was as follows (1914 figures are given in brackets):—Wheat, 65,274,000 qr. (65,097,000); rye, 1,317,000 qr. (1,775,700); barley, 47,189,000 qr. (42,553,350); buckwheat, 4,202,800 qr. (2,909,500); maize, 7,379,000 qr. (8,460,500); and oats, 90,812,000 qr. (80,834,000); whilst the production of potatoes was 20,451,000 tons as compared with 19,815,000 tons in 1914.—(*Broomhall's Corn Trade News*, 16th February.)

From reports received from correspondents up to the 14th November, it appeared that the area sown with winter crops was considerably less than last season, but as a result of further inquiries the Department of Rural Economy and Household Statistics states that the decrease was of no special importance in most localities, but in the south of the country and in a wide district in the south-east there was a considerable reduction, whilst in the extreme east of European Russia the acreage sown is 40 per cent. or more less than last season.—(*Broomhall's Corn Trade News*, 10th February.)

Canada.—A bulletin issued by the Census and Statistics Office at Ottawa, on the 19th January, states that the quality of the grain crops in 1915 was, on the whole, superior to that of last year, and also to the average of the last 5 years. The weight per bush. of the crops was as follows:—autumn wheat, 59·71 lb.; spring wheat, 60·31 lb.; all wheat, 60·19 lb.; oats, 36·61 lb.; barley, 48·26 lb.; buckwheat, 48·02 lb.; linseed, 55·28 lb.; and maize, 56·32 lb.

United States.—According to a report, issued on the 8th March by the Statistician of the Department of Agriculture, the estimate of stocks of grain in farmers' hands in the United States, on 1st March, were as follows (stocks on the same date in 1915 in brackets): Wheat 242,000,000 bush. (152,903,000 bush.); oats, 597,000,000 bush. (379,369,000 bush.); barley, 61,000,000 bush. (42,889,000 bush.); and maize, 1,139,000,000 bush. (910,894,000 bush).—(*Broomhall's Corn Trade News*, 8th March).

Argentina.—According to an estimate issued by the Ministry of Agriculture on the 2nd March, the acreage under maize this season is 9,929,000 acres as compared with 10,381,000 acres in 1914-15. (*London Grain, Seed and Oil Reporter*, 3rd March).

Welcome heavy rains fell over the provinces of Buenos Aires, Entre Ríos, Santa Fe and Córdoba on the 15th and 16th January. The maize situation was beginning to look very black before this, and even as it is, some considerable loss has resulted from drought in Santa Fe and Córdoba. The benefit to the maize by these last rains has been enormous, and an excellent harvest yield can still reasonably be hoped for.—(*Review of the River Plate*, 21st January.)

Climatic conditions favourable to harvest operations prevailed during the fourth week of January. Generally, the results of the wheat, oats and linseed harvests continue to be good, and well up to expectations.—(*Review of the River Plate*, 28th January.)

Australia.—According to the *South Australian Register* the official forecast of the production of wheat in 1915-16, in Australia, excluding Queensland, is 164,407,353 bush., as compared with 24,813,536 bush. in 1914-15, and 103,334,132 bush. in 1913-14, in the whole of Australia. —(*The London Grain, Seed and Oil Reporter*, 24th February).

Live Stock in France.—The numbers of farm stock in November-December, 1915, are as follows (the corresponding figures at 1st July, 1915, being shown in brackets):—Horses, 2,156,424 (2,227,209); cattle, 12,514,414 (12,286,849); sheep, 12,379,124 (13,483,189); pigs, 4,915,780 (5,490,796).—(*Bulletin of Agricultural and Commercial Statistics*, February, 1916.)

THE crop reporters of the Board, in reporting on agricultural conditions in England and Wales during February, state that owing to

Agricultural Conditions in England and Wales on 1st March. the unfavourable character of February, wheat shows but little advance during the month. As on 1st February, the earlier-sown is generally satisfactory, but that got in late, or on the heavier and wetter soils, is generally rather poor and backward.

Winter oats and beans are looking well, though the beans are often backward. About a third of the wheat requires, or at least would derive benefit from, a top-dressing during the spring.

The month having been very unsettled, but little spring work has been done. During the first half, some progress was made with the preparation of the land, and some spring wheat was sown in many parts

of the country. But during the second fortnight the bad weather, accompanied by very heavy snow in the midlands and south, stopped all work. Practically no other spring corn was got in anywhere, and field work is, upon the whole, rather backward. Vegetation was, however, generally very forward, and the snowy weather has given it a not unwelcome check, particularly in fruit-growing districts.

Seeds are nearly everywhere healthy and vigorous, promising very good crops, though here and there the recent weather has caused some damage.

The condition of ewes is generally average or satisfactory, and lambing prospects are good. In a few of the southern counties lambing is in full swing, and elsewhere it is beginning, except in hilly districts. The fall of lambs is stated nearly everywhere to be quite up to the average, and above it in some parts; and complaints of weak lambs or of unusual losses are relatively few; although fears are expressed that a continuance of the very bad weather may cause many deaths.

Outlying stock have only done poorly during the month, but the general condition of the animals is, nevertheless, satisfactory in view of the very trying conditions. The heavy snow caused stock to be housed again. Keep is getting rather scarce, especially hay and straw, although the amount on hand is very variable in different parts of the country, some districts having ample. The open weather which prevailed until the middle of February, giving plenty of grass feed in the open, was useful in saving a good deal of roots and fodder, and the general view is that there will be just sufficient to last for the remainder of the season.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st March, the supply of labour was everywhere very scarce and getting scarcer. Not very much was required

Agricultural Labour during February as comparatively little work in **England and Wales** could be done, but many fears were expressed during February, that there will not be enough help in the busy sowing season. The conditions in the different districts were as follows:—

Northumberland, Durham, Cumberland and Westmorland.—The supply of labour was very deficient, and the shortage was expected to be seriously felt as the spring advances.

Lancashire and Cheshire.—The labour supply was very short over the whole district, and it is anticipated that the difficulty will become aggravated as the spring advances and the demand increases with more favourable weather for spring sowing.

Yorkshire.—The supply of labour continues to decrease and is now very short generally. It is expected that spring sowing will be delayed in consequence.

Shropshire and Stafford.—Everywhere labour was scarce, and farmers were having difficulty in keeping the work going.

Derby, Nottingham, Leicester, and Rutland.—Labour was deficient or very short throughout the district.

Lincoln and Norfolk.—The supply of labour was practically everywhere very short, rather more so than last month.

Suffolk, Cambridge, and Huntingdonshire.—The supply of labour was everywhere short, but it was not much felt during February as little work was possible.

Bedford, Northampton, and Warwick.—Farm workers were very scarce and wages have risen in some districts.

Buckingham, Oxford, and Berkshire.—Labour was reported to be deficient in every district, and with drier weather the shortage will be more severely felt.

Worcester, Hereford, and Gloucester.—The supply of labour was everywhere very short, and wages still tend to rise.

Cornwall, Devon, and Somerset.—The supply of labour was everywhere deficient, and the shortage will be seriously felt with an improvement in the weather. It is anticipated that wages will rise at the Lady-day hirings.

Dorset, Wiltshire, and Hampshire.—The supply of labour was everywhere deficient, but the shortage has not yet been so severely felt owing to the bad weather preventing work upon the land. Wages have increased, and herdsmen, cowmen and shepherds are in demand.

Surrey, Kent and Sussex.—Labour was very deficient, more especially among cattlemen and horsemen.

Essex, Hertford, and Middlesex.—The supply of labour was short throughout the district, and the scarcity will be more felt with an improvement in the weather.

North Wales.—Labour was scarce in practically every district.

Mid Wales.—Labour was very scarce in practically every part of the division.

South Wales.—The supply of labour was reported to be very short in most districts, and the outlook was considered to be very unsatisfactory.

The following statement shows that according to the information in the possession of the Board on 1st March, 1916, certain diseases of animals existed in the countries specified:—

Prevalence of Animal Diseases on the Continent.

Austria (on the 19th Jan.). Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of Jan.).

Anthrax, Foot-and-Mouth Disease (223 outbreaks), Glanders and Farcy, Swine Erysipelas.

France (for the period 6th—19th Feb.).

Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Germany (for the period 1st—15th Jan.).

Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of Jan.).

Anthrax, Foot-and-Mouth Disease (55 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 19th Jan.).

Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox, Swine Erysipelas, Swine Fever.

Italy (for the period 7th—13th Feb.).

Anthrax, Blackleg, Foot-and-Mouth Disease (1,946 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever.

Norway (month of Jan.).

Anthrax, Swine Fever.

Rumania (for the period 14th—21st Feb.).

Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders, Rabies, Sheep-pox, Sheep-scab, Swine Fever.

Russia (month of Sept.).

Anthrax, Foot-and-Mouth Disease (299,922 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of Nov.).

Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of Jan.).

Anthrax, Blackleg, Swine Erysipelas,

Switzerland (for the period 14th—20th Feb.).

Anthrax, Blackleg, Foot-and-Mouth Disease (36 "étables" entailing 420 animals, of which 2 "étables" were declared infected during the period), Rabies, Swine Fever.

No further returns have been received in respect of the following countries:—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during February.

District.	Temperature.		Rainfall.		Bright Sunshine.			
	Daily Mean.	Diff. from Average.	Amount.	Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.	
	°F.	°F.	In.	Mm.*	Mm.*	Hours.	Hours.	
<i>Week ending Feb. 5th:</i>								
England, N.E.	42°0	+3°4	0.38	10	+ 1	4	1°5	- 0°6
England, E.	41°2	+2°3	0.38	9	- 1	4	1°1	- 1°3
Midland Counties	42°1	+3°1	0.71	18	+ 5	3	1°5	- 0°4
England, S.E.	42°4	+2°0	0.34	21	+ 8	4	1°7	- 0°3
England, N.W.	43°3	+3°4	1.00	25	+ 7	5	1°2	- 0°5
England, S.W.	43°9	+2°3	1.53	39	+18	4	1°5	- 0°6
English Channel ...	45°3	+0°9	0.35	22	+ 5	4	2°2	- 0°3
<i>Week ending Feb. 12th:</i>								
England, N.E.	38°7	0°0	0.60	15	+ 5	4	3°9	+1°5
England, E.	39°4	+0°9	0.53	13	+ 4	4	3°9	+1°4
Midland Counties	38°5	-0°2	0.72	18	+ 6	4	3°7	+1°5
England, S.E.	40°8	+0°9	0.71	18	+ 5	5	3°8	+1°6
England, N.W.	39°9	+0°4	1.20	36	+14	6	2°3	+0°3
England, S.W.	41°2	0°0	1.41	36	+17	6	2°5	+0°2
English Channel ...	44°8	+0°7	1.71	43	+27	7	3°0	+0°2
<i>Week ending Feb. 19th:</i>								
England, N.E.	39°7	+1°3	0.62	16	+ 7	5	3°3	+0°6
England, E.	42°3	+4°5	1.66	27	+18	6	3°3	+0°5
Midland Counties	41°5	+2°1	1.13	29	+18	6	2°6	+0°2
England, S.E.	44°1	+4°3	1.19	39	+18	6	3°6	+0°9
England, N.W.	41°4	+1°8	1.44	37	+23	6	1°8	-0°6
England, S.W.	44°2	+3°2	1.84	47	+29	7	2°3	-0°3
English Channel ...	47°7	+3°8	1.32	34	+18	7	2°3	-0°9
<i>Week ending Feb. 26th:</i>								
England, N.E.	35°1	-3°4	0.75	19	+11	5	1°7	-1°0
England, E.	34°3	-4°1	1.66	27	+19	6	1°0	-1°9
Midland Counties	33°6	-4°9	0.77	19	+ 9	5	1°1	-1°4
England, S.E.	34°3	-5°4	1.14	29	+18	5	1°5	-1°5
England, N.W.	36°0	-3°4	0.19	5	- 8	2	3°3	+0°4
England, S.W.	35°2	-5°8	0.83	21	+ 4	6	2°3	-0°6
English Channel ...	39°7	-4°3	1.73	44	+29	6	2°1	-1°5

* 1 inch = 25.4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked
or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	FEBRUARY,		TWO MONTHS ENDED FEBRUARY.	
	1916.	1915.	1916.	1915.
Anthrax:—				
Outbreaks	54	67	117	155
Animals attacked	63	75	128	175
Foot-and-Mouth Disease:—				
Outbreaks	1	—	1	—
Animals attacked	24	—	24	—
Glanders (including Farcy):—				
Outbreaks	7	4	13	7
Animals attacked	20	6	44	11
Parasitic Mange:—				
Outbreaks	297	* —	787	* —
Animals attacked	655	* —	1,093	* —
Sheep-Scab:—				
Outbreaks	35	28	132	107
Swine Fever:—				
Outbreaks	319	284	704	691
Swine Slaughtered as diseased or exposed to infection	922	1,055	2,166	2,837

* The Parasitic Mange Order of 1911 was suspended from 6th August, 1914,
to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and
Technical Instruction for Ireland.)

DISEASE.	FEBRUARY,		TWO MONTHS ENDED FEBRUARY.	
	1916.	1915.	1916.	1915.
Anthrax:—				
Outbreaks	—	—	1	—
Animals attacked	—	—	5	—
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	—
Animals attacked	—	—	—	—
Glanders (including Farcy):—				
Outbreaks	—	—	—	—
Animals attacked	—	—	—	—
Parasitic Mange:—				
Outbreaks	0	5	18	10
Sheep-Scab:—				
Outbreaks	57	62	142	131
Swine Fever:—				
Outbreaks	18	19	36	39
Swine Slaughtered as diseased or exposed to infection	68	149	105	248

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES OF LIVE STOCK in ENGLAND and WALES
in February and January, 1916.(Compiled from Reports received from the Board's Market
Reporters.)

Description.	FEBRUARY.		JANUARY.	
	First Quality.	Second Quality.	First Quality.	Second Quality.
FAT STOCK:—				
Cattle:—	per stone.*	per stone.*	per stone.*	per stone.*
Polled Scots ...	11 9	11 2	11 4	11 1
Herefords ...	11 8	10 7	11 2	10 2
Shorthorns ...	11 7	10 8	11 3	10 4
Devons ...	11 8	10 4	11 5	10 3
Welsh Runts ...	11 4	10 10	11 0	10 5
	per lb.*	per lb.*	per lb.*	per lb.*
Veal Calves ...	d.	d.	d.	d.
		9 1	10	9
Sheep:—				
Downs ...	12 1	11 1	11 1	10 1
Longwools ...	12	10 1	11	10
Cheviots ...	13 1	12	11 1	10 1
Blackfaced ...	13	11 1	11 1	10 1
Welsh ...	11 1	10 1	10 1	9 1
Cross-breds ...	12 1	11 1	11 1	10 1
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs:—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs ...	11 1	10 4	10 7	9 11
Porkers ...	11 11	11 3	11 6	10 10
LEAN STOCK:—				
Milking Cows:—	per head.	per head.	per head.	per head.
Shorthorns—In Milk ...	£ s.	£ s.	£ s.	£ s.
" —Calvers ...	29 14	24 3	29 12	24 2
" —Calves ...	29 7	23 19	29 1	23 0
Other Breeds—In Milk ...	27 4	23 6	28 0	24 2
" —Calvers ...	—	20 0	21 10	19 10
Calves for Rearing ...	2 17	2 4	2 15	2 2
Store Cattle:—				
Shorthorns—Yearlings ...	13 6	11 7	12 15	10 16
" —Two-year-olds ...	17 18	16 4	17 5	15 3
" —Three-year-olds ...	23 18	20 14	22 14	19 7
Herefords —Two-year-olds ...	20 1	16 11	19 0	15 7
Devons — "	18 17	16 11	18 4	16 0
Welsh Runts — "	18 15	17 5	17 7	—
Store Sheep:—				
Hoggs, Hoggets, Tegs, and Lambs:—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	58 6	51 1	53 6	45 7
Store Pigs:—				
8 to 12 weeks old ...	26 11	20 1	25 8	18 9
12 to 16 weeks old ...	46 5	35 10	44 7	34 4

* Estimated carcass weight.

**AVERAGE PRICES of DEAD MEAT at certain MARKETS in
ENGLAND in February, 1916.**

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality	Birming-	Leeds.	Liver-	Lon-	Man-
		ham.	pool.	don.	chester.	
		s. d.	s. d.	s. d.	s. d.	s. d.
		per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
BEEF:—						
English	1st	77 0	76 0	—	78 6	74 6
	2nd	71 6	73 0	—	74 0	71 0
Cow and Bull	1st	70 0	71 0	66 6	66 0	69 6
	2nd	65 6	66 0	59 6	64 0	64 6
Irish: Port Killed	1st	73 0	73 0	73 6	76 0	72 6
	2nd	70 0	71 6	69 0	72 0	67 6
Argentine Frozen—						
Hind Quarters	1st	67 6	73 6	70 0	—	70 0
Fore " "	1st	58 6	58 6	60 6	—	60 6
Argentine Chilled—						
Hind Quarters	1st	75 6	72 6	72 6	74 6	73 6
Fore " "	1st	61 0	60 6	62 0	61 0	62 0
Australian Frozen—						
Hind Quarters	1st	64 6	—	69 0	—	69 0
Fore " "	1st	55 0	—	60 6	—	60 6
VEAL:—						
British	1st	—	—	—	106 0	—
	2nd	92 0	—	—	97 0	—
Foreign...	1st	—	—	—	111 0	—
MUTTON:—						
Scotch	1st	96 0	97 0	106 0	104 0	105 6
	2nd	94 0	93 6	98 0	95 6	101 6
English	1st	95 0	98 0	—	93 6	101 0
	2nd	91 6	94 0	—	88 0	97 0
Irish: Port Killed	1st	91 6	—	96 0	88 6	97 6
	2nd	89 6	—	88 0	84 0	92 6
Argentine Frozen	1st	72 6	71 0	70 6	71 6	70 6
Australian " "	1st	69 6	70 0	70 0	68 6	70 0
New Zealand " "	1st	71 0	72 6	—	73 0	—
LAMB:—						
British	1st	116 6	—	—	115 6	—
	2nd	107 6	—	—	106 0	—
New Zealand	1st	79 6	77 6	79 6	78 6	79 6
Australian	1st	76 6	—	77 0	76 0	77 0
Argentine	1st	74 0	76 0	76 6	76 0	76 6
PORK:—						
British	1st	102 0	93 6	104 6	101 0	97 6
	2nd	95 0	89 0	95 6	91 6	93 6
Frozen	1st	74 0	75 0	80 6	74 6	77 0

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in February, 1916.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	BRISTOL.		LIVERPOOL.		LONDON.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
BUTTER:—	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
British ...	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
... ...	19 0	18 0	—	—	19 0	18 0
Irish Creamery—Fresh	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
" Factory ...	131 0	123 6	128 0	119 6	—	—
Danish ...	—	—	164 6	162 0	161 6	158 6
French ...	—	—	—	—	159 6	153 6
Russian ...	127 6	121 0	—	122 0	130 0	122 0
Canadian ...	150 0	146 0	150 0	146 0	—	—
Australian ...	152 6	148 6	151 6	147 6	159 0	151 6
New Zealand ...	156 6	154 6	156 0	154 0	162 0	154 6
Argentine ...	150 6	146 6	148 6	145 6	152 6	146 6
CHEESE:—						
British—						
Cheddar ...	107 0	99 6	108 0	104 6	107 6	101 6
Cheshire ...	—	—	120 lb.	120 lb.	120 lb.	120 lb.
Canadian ...	101 6	97 6	122 0	117 6	123 6	116 0
per cwt.	101 6	97 0	100 0	100 0	100 0	98 0
BACON:—						
Irish (Green) ...	106 0	101 6	104 6	100 6	106 0	100 6
Canadian (Green sides) ...	92 0	87 6	92 0	86 0	94 6	88 6
HAMS:—						
York (Dried or Smoked) ...	148 6	140 6	—	—	150 6	141 0
Irish (Dried or Smoked) ...	—	—	—	—	142 0	136 0
American (Green) (long cut) ...	84 6	81 0	86 6	81 6	88 0	84 0
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British ...	17 8	—	—	—	18 4	17 1
Irish ...	17 1	—	16 10	15 11	17 6	16 7
American ...	11 4	—	10 6	9 6	11 3	10 3
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
British Queen ...	98 6	85 0	—	—	106 0	97 6
Edward VII. ...	108 0	98 0	76 6	73 6	102 6	95 6
Up-to-date ...	98 0	90 0	70 0	65 0	100 0	91 6
HAY:—						
Clover ...	—	—	166 0	130 0	136 0	128 6
Meadow ...	—	—	—	—	132 0	123 0

AVERAGE PRICES of British Corn per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1914, 1915 and 1916.

Weeks ended (in 1916).	WHEAT.			BARLEY.			OATS.		
	1914.	1915.	1916.	1914.	1915.	1916.	1914.	1915.	1916.
Jan.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
8...	30 11	46 2	55 8	25 11	29 7	47 8	18 4	26 5	31 5
" 15...	31 0	48 9	59 5	26 0	30 5	48 6	18 6	27 6	31 11
" 22...	30 11	51 6	57 2	26 3	31 3	49 6	18 11	28 10	32 6
" 29...	31 1	52 8	58 0	26 6	32 5	51 0	19 1	29 10	32 11
Feb.	5...	31 0	53 3	58 3	26 7	33 7	52 5	18 9	30 3
" 12...	31 0	54 8	57 6	26 7	34 7	52 10	18 11	31 1	32 2
" 19...	31 0	56 0	56 11	26 7	34 11	53 6	18 11	31 5	31 9
" 26...	31 0	56 0	58 2	26 6	35 3	54 2	18 11	31 8	32 2
Mar.	4...	31 1	55 11	59 4	26 2	34 6	55 7	18 9	31 8
" 11...	31 6	54 8	58 2	26 0	33 5	55 6	18 7	31 0	32 3
" 18...	31 5	53 9		25 8	32 2		18 6	30 7	
" 25...	31 4	54 3		25 7	31 11		18 8	30 6	
Apl.	1...	31 6	54 6		25 6	31 9		18 5	30 6
" 8...	31 5	54 9		26 8	31 3		18 4	30 4	
" 15...	31 7	55 4		25 4	30 10		18 4	30 5	
" 22...	31 9	56 5		26 6	31 5		18 5	30 11	
" 29...	31 9	58 3		26 0	32 7		18 5	31 5	
May	6...	32 2	60 5		25 6	33 3		18 9	32 4
" 13...	32 7	61 7		26 3	34 0		18 11	32 5	
" 20...	33 0	62 0		25 10	34 1		19 0	32 8	
" 27...	33 9	61 11		26 1	34 8		19 4	32 7	
June	3...	34 0	61 9		25 11	35 4		19 4	32 5
" 10...	34 1	60 1		24 11	34 5		19 8	32 4	
" 17...	34 1	56 1		25 10	34 3		19 9	31 9	
" 24...	34 3	52 0		25 4	34 4		20 0	31 9	
July	1...	34 4	49 5		24 6	35 3		19 9	31 1
" 8...	34 2	50 1		24 9	34 7		20 0	31 6	
" 15...	34 1	52 7		24 2	35 8		19 10	31 6	
" 22...	34 0	53 10		24 7	35 10		19 9	32 1	
" 29...	34 2	55 3		25 9	36 1		19 8	31 1	
Aug.	5...	34 9	55 4		25 2	35 7		19 1	31 5
" 12...	40 3	55 2		29 4	37 0		25 1	31 7	
" 19...	38 9	54 3		29 10	39 4		24 3	31 4	
" 26...	36 2	51 11		30 3	38 3		23 5	30 0	
Sept.	2...	36 5	45 3		30 6	38 1		23 9	26 10
" 9...	37 10	43 0		29 11	37 11		23 11	26 8	
" 16...	38 3	42 9		29 5	39 0		23 8	26 4	
" 23...	37 6	43 3		29 3	39 8		23 3	26 1	
" 30...	37 1	43 5		29 1	40 4		22 9	26 5	
Oct.	7...	36 8	44 1		28 10	41 0		22 5	26 5
" 14...	36 7	45 9		28 8	42 3		22 4	27 1	
" 21...	37 2	48 2		28 7	44 0		22 5	28 1	
" 28...	37 10	50 3		28 3	46 2		23 7	29 1	
Nov.	4...	38 8	51 6		28 6	47 3		23 7	30 4
" 11...	39 8	52 8		29	47 5		24 8	30 11	
" 18...	41 0	53 6		29	47 11		25 5	31 3	
" 25...	41 11	54 2		30	3 48 7		25 8	31 1	
Dec.	2...	42 2	53 7		30	2 48 11		25 9	30 11
" 9...	42 1	52 10		29 11	47 10		25 9	30 4	
" 16...	42 7	53 11		29	47 5		25 9	30 6	
" 23...	43 3	53 10		29	47 2		25 11	30 7	
" 30...	44 4	54 9		29 10	47 5		26 6	30 10	

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley, and Oats** at certain Markets during the Month of February, 1914, 1915, and 1916.

	WHEAT.			BARLEY.			OATS.			
	1914.		1915.	1914.		1915.	1914.		1915.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	
London	32	2	57	1	58	11	26	8	35	0
Norwich	30	8	54	3	56	1	26	0	34	8
Peterborough	30	4	55	1	56	11	25	11	35	1
Lincoln	31	1	55	0	58	5	27	1	34	10
Doncaster	31	2	53	10	58	5	26	9	33	4
Salisbury	30	3	54	0	57	4	25	4	35	3

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India, Imperial Department of Agriculture.—Memoirs. Botanical Series. Vol. VII, No. 8.—The Inheritance of some Characters in Wheat. II. (273-285 pp., + viii. plates.) Calcutta, 1915. 2s. od. [63.311 (04).] *Wren, R. C.*—Potter's Cyclopaedia of Botanical Drugs and Preparations. (330 pp.) London: Potter & Clarke, n.d. 3s. 6d. [63.348.] *Edinburgh and East of Scotland College of Agriculture*.—Varieties of Oats and Barley. (10 pp.) Edinburgh [1915]. [63.314; 63.313.] *Gras, N. S. B.*—The Evolution of the English Corn Market from the XIIth to the XVIIth century. (498 pp.) Cambridge (U.S.A.): Harvard University Press; London: Oxford University Press, 1915. 10s. 6d. net. [63.31; 38.] *Salop County Council*.—Report on Wheat Varieties, 1915. (7 pp.) Shrewsbury, 1915. [63.311 (04).] *Dorset County Council, Education Committee*.—Agricultural Leaflet No. 2: Potato Experiments, 1915. (7 pp.) Dorchester: County Offices, 1915. [63.512 (04).] *Mauritius, Department of Agriculture*.—General Series. Bull. 5:—The Fibre Industry of Mauritius. (15 pp.) Port Louis, Mauritius, 1915. [63.341.] *Oklahoma Agricultural Experiment Station*.—Bull. 103:—Sudan Grass. (14 pp.) Stillwater, Ok., 1915. [63.33 (d).] *U.S. Department of Agriculture*.—Bull. 310:—Willows: Their Growth, Use and Importance. (52 pp.) Washington, 1915. [63.3412.] *U.S. Department of Agriculture*.—Farmers' Bull. 693:—Bur Clover. (14 pp.) Washington, 1915. [63.33 (b).]

Horticulture—

Stebbins, C. A.—The Principles of Agriculture through the School and the Home Garden. (380 pp.) New York and London: The Macmillan Company, 1915. 4s. 6d. net. [63.5 (07).] *Oregon Agricultural Experiment Station*.—Bull. 124:—Comparative Cooking Qualities of some of the Common Varieties of Apples grown in Oregon. (36 pp.) Corvallis, Oregon, 1915. [63.41 (a).] *New Mexico Agricultural Experiment Station*.—Bull. 89:—Hardiness of Fruit Buds and Flowers to Frost. (52 pp.) State College, New Mexico, 1914. [63.41 (04).]

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Sander, A.—Deutschlands Kampf mit dem Kartoffelkäfer. —(*Chrysomela (Doryphora) decentinella*). (46 pp.) M. Gladbach: Volksverein-Verlag, 1914. 60 pf. [63.27.] *Wisconsin Agricultural Experiment Station*.—Research Bull. 37:—Germination and Infection with the Fungus of the Late Blight of Potato. (*Phytophthora infestans*). (64 pp.) [63.24.] Research Bull. 38:—The Control of Cabbage Yellows caused by *Fusarium conglutinans* through Disease Resistance. (70 pp.) [63.24.] Madison, Wis., 1915. *Virginia Truck Experiment Station*.—Bull. 14:—Control of the Colorado Potato Beetle (*Leptinotarsa decemlineata*, Say.). (315-333 pp.) Norfolk, Va., 1915. [63.27.] *West Virginia Agricultural Experiment Station*.—Bull. 15:—Apple Rust. (73 pp.) Morgantown, West Virginia, 1915. [63.24.]

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U.S. Department of Agriculture.—Bull. 313:—Features of the Sheep Industries of United States, New Zealand, and Australia compared. (35 pp.) Washington, 1915. [63.6(73); 63.6(9).]

Dairying and Food, General—

Lauder, A. and Fagan, T. W..—On the Composition of Milk as affected by Increase of the Amount of Calcium Phosphate in the Rations of Cows. (195-202 pp.) [Proc. Roy. Soc. Edinburgh, Vol. XXXV., Pt. II., No. 19], 1915. 6d. [63.712; 63.711(a).]

Wye, South-Eastern Agricultural College.—Fourth Report on the Cost of Food in the Production of Milk in the Counties of Kent and Surrey. (95 pp.) Wye, 1915. Residents, 1s.; Non-residents, 2s. [63.711; 63.714.]

West Sussex Milk Recording Society.—Report on Milk Yields and Cost of Food. (22 pp.) Chichester, 1915. [63.711(b); 63.714.]

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U.S. Department of Agriculture.—Farmers' Bull. 666:—Foot-and-Mouth Disease. (16 pp.) Washington, 1915. [619.2(d).]

Edinburgh and East of Scotland College of Agriculture.—Pathology and Epidemiology of Swine Fever. (40 pp.) Edinburgh, 1915. [619.4(a).]

Edinburgh and East of Scotland College of Agriculture.—Epidemiology and Pathology of Chicken Cholera. (26 pp.) Edinburgh, 1915. [619.5(a).]

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Craig, R. A..—Common Diseases of Farm Animals. (334 pp.) Philadelphia and London: J. B. Lippincott Company, 1915. 81.50 net. [619.02.]

Nuttall, G. H. F. and Warburton, C..—Ticks: A Monograph of the Ixodoidea. Part III. The Genus *Haemaphysalis*. (349-550 pp. + plates VIII.-XIII.). Cambridge: University Press, 1915. 12s. net. [59.169(b).]

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Brown, E..—Poultry Husbandry. (416 pp.) London: E. Arnold, 1915. 8s. od. net. [63.65(02).]

Broomhead, W. W..—Egg Production on the Intensive System. (81 pp.) London: "Poultry" Offices, 1915. 1s. [63.651(04).]

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Turnor, C..—Land Settlement after the War. (101-120 pp.) [Jour. Farmers' Club, December, 1915.] London, 1915. 6d. [331.]

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INDEX TO VOL. XXII.

(APRIL, 1915, TO MARCH, 1916.)

NOTE.—References to Insects, &c., and Fungi are indexed under the headings "Insects, &c.," and "Fungi" only, to Weeds under the heading "Weeds" only, to Fruit under the heading "Fruit" only, to Diseases of Animals under the heading "Diseases of Animals" only, and to Import and Export Regulations under the heading "Import and Export Regulations" only.

References to matters connected with the effect of the War on Agriculture are indexed under the heading "War and Agriculture."]

The names of the research and experiment stations at which the experiments summarised in the *Journal* have been conducted are indicated in italics, thus:—(Rothamsted). In the case of experiments conducted abroad, the name of the country is given.

Articles or reports on the following subjects appear in the *Journal* each month, or from time to time, and are not separately indexed:—Unit Prices of Artificial Manures, Notes on Crop Prospects and Live Stock Abroad, Notes on the Weather, Notes on Agricultural Labour in England and Wales, Notes on Agricultural Conditions in England and Wales, Prices of Agricultural Produce, Outbreaks under the Diseases of Animals Acts, Prevalence of Animal Diseases on the Continent, Lists of Additions to the Board's Library, and Selected Contents of Periodicals.

Acorns, had effect on laying hens (<i>Germany</i>)	902
" feeding to live stock	686
Afforestation, see <i>Forestry</i> .	
Agricultural Organisation Society, Development Commission's report for 1914-15 on grant	1175
Agricultural research, see <i>Research</i> .	
Agricultural returns and statistics (see also <i>Crops</i> , <i>Live Stock</i> , <i>Labour</i> , and <i>Prices</i>):	
Area under crops in England and Wales, 1914 (Part I., 1914)	475
" " 1915	596
" " in the United Kingdom	59, 506, 701, 1189
Corn prices, annual averages, 1909-1915	1037
" pulse and hay crops, acreage and produce in 1915	817
Exports in 1915	1160
Grain, imports in the cereal year, 1914-15	579
Hops, acreage in 1915	595
" produce in 1915	816
Imports of agricultural produce	514, 519, 579, 986
Index number	911
International Institute of Agriculture:	
Bulletin of agricultural and commercial statistics	377
Third year-book of agricultural statistics	815
Live stock, numbers in England and Wales, 1915	59, 509, 701, 1189
" " the United Kingdom	910
Potato crops, acreage and yield in 1915	511, 906
Prices and supplies of agricultural produce in 1914	373
Produce of crops in England and Wales, 1914	90, 509, 1189
" " in the United Kingdom	910
Root crops, acreage and yield in 1915	466
Ireland, area under crops and number of live stock, 1915	467
Scotland, area under crops and number of live stock	
Allotments, see <i>Small Holdings and Allotments</i> .	
Amos, A. : The failure of a crop of barley	313
Animals Division of the Board, report for 1914	87
Apples, see <i>Fruit</i> .	
Army, see <i>War and Agriculture</i> .	
Ashby, A. W. : Suggestions from America for co-operative selling	201, 370
Ashes, see <i>Manures</i> .	
Atmospheric impurities and plant growth (<i>Leeds</i>)	168
Australian meat export trade report of commission of enquiry	469
	A 2

	PAGE
Bacon, cause of black discoloration (<i>Cambridge</i>)	1304
" Hitchin factory	317
Bacteriology : Colon bacilli, ability to survive pasteurisation (<i>U.S.</i>) ...	288
Condensing and drying of milk, effect on bacterial content ...	287
Eggs, bacterial content (<i>U.S.</i>)	167
Electricity, destruction of milk bacteria by	1229
Peat, bacterised, as manure (<i>Midland</i>)	1297
" inoculation of crops with (<i>Woburn</i>) ...	484
Serum injection for treatment of swine fever	594, 691, 702
Sterilisation of soil by steaming (<i>U.S.</i>) ...	807
" " partial, by antiseptics ...	158
" " with lime ...	255
South Africa, inoculation of cattle in Rhodesia against the plasmoses	476
Barker, B. T. P. : Disorders of cider and perry ...	939
Summer sprays against American gooseberry-mildew ...	1244
The use of pressed apple pomace ...	851
Barley (see also <i>Corn</i> and <i>Crops</i>) : Acreage and Produce in 1914	90
1915 ...	701, 817, 1189
Failure of a barley crop, description and reasons ...	313
Green manuring (<i>Rothamsted</i>) ...	355
Growth after leguminous crops (<i>Rothamsted</i>) ...	355
Growth of two white straw crops in succession ...	533
Malt culms, use as a feeding stuff ...	239, 302
Manuring (<i>Northants C. C.</i>) ...	70
" in spring of 1916 ...	1275
Prices of British barley, averages ...	581, 1037
Rate of seeding (<i>Harper Adams</i>) ...	262
Varieties (<i>Chelmsford</i>) ...	69
" (<i>Edinburgh</i>) ...	1011
" (<i>Harper Adams</i>) ...	262
" (<i>Ireland</i>) ...	69
" (<i>Woburn</i>) ...	898
Basic slag, see <i>Manures</i> .	
Basket-making ...	1089
Bathurst, Capt. C., speech at food supply meeting ...	501
Beans (see also <i>Soya Beans</i>) : Acreage and Produce in 1914	90
1915 ...	.. 817, 1189
Growth ...	29
Manuring ...	1271
Use as a feeding stuff ...	305
Beef, see <i>Meat</i> .	
Beet, see <i>Sugar Beet</i> .	
Bees, pollination of fruit trees by ...	419
Belgium : Poultry keeping at Lippeloo ...	329
Berry, G. P. : Notes on lime washes ...	1125
Berry, R. A. : Composition of wood and plant ash ...	766
Biffen, R. H. : Report on an enquiry into the quality of farm seeds, 1912-14	1041
The selection of wheats for spring sowing ...	867
Birds : Harmful birds, methods of combating and destruction ...	1164
Pigeon breeding for utility purposes ...	335
Woodpeckers, and their relation to forestry ...	789
Board of Agriculture and Fisheries (see also <i>War and Agriculture</i>) :	
Agricultural consultative committee ...	178
Agricultural returns and statistics, see <i>Agricultural Returns</i> .	
Allotments, President's circular letter as to increase of food production	1011
Allotments, report on, 1914 ...	281
American gooseberry mildew orders of 1915 ...	278, 279
" warning ...	177
Animals Division, report for 1914 ...	87
Canadian cattle, deputation as to importation ...	590
Chief veterinary officer's report for 1914 ...	700, 704
Commercial Control Branch, reports for 1914 and 1915 ...	374, 1259
Common, grazing in ...	1291
Demonstrations of motor ploughs and tractors ...	760
Development Fund grants, see <i>Development Fund</i> .	
Education, see <i>Education</i> .	
Egg collection for wounded soldiers ...	176, 699
Egg-laying competitions of the Harper Adams College and the Utility	
Poultry Club ...	594, 808

Board of Agriculture and Fisheries— <i>continued.</i>	PAGE
Eggs, description as fresh and new laid	390
Fertilisers and Feeding Stuffs Act, 1906, facilities for sampling and analysis	702
Fertilisers, committee to control supplies	811, 1015, 1180
Food supply meeting, Lord Selborne's and other speeches	469
Foot-and-mouth disease outbreaks	914, 919, 1921, 1179, 1308
Grain, purchase by Government	1013
Home-grown timber committee	1019
Home production of food, circular letters as to need for increase	816, 1186
Horses, committees on	370, 494, 585, 803
Horses, see <i>Live Stock—Horses.</i>	
Horticulture Branch, report for 1914-15	931
Indian Wheat Committee	180, 372
International Institute of Agriculture: Monographs on Agricultural Co-operation; Vol. II., sale by the Board	370
Third year-book of agricultural statistics, sale by the Board	815
Journal supplement: Report on the poultry industry in Wales	694
Kew Gardens, charges for admission	1019
Labour, measures suggested and adopted to deal with shortage, see <i>Labour and War and Agriculture.</i>	
Land settlement for discharged soldiers and sailors, committee to consider	463, 813, 1166, 1188
Leaflets in 1915	373, 1020
" issue of third bound volume	1021
" special	87, 468, 698, 1020
Live Stock, see <i>Live Stock.</i>	
Maintenance of Live Stock Act, 1915	468
Order, 1915	591, 1018
Military Service Act, 1916, notice to farmers	1181
Milk records certificate, value	1392
National Insurance Act, 1911, regulations	700
Parasitic mange amongst cast army horses, circular letter	700
Poultry keeping, local restrictions under Public Health Act, 1875	1021
Poultry, scheme for distributing sittings of eggs of pure breeds	812
Rabies in an imported dog	177
Sale of Food and Drugs Acts, circular letter as to hardship in sale of milk	908
Selborne, Lord, appeal to farmers in England and Wales	679
Slaughter of animals	182, 370, 468, 469, 702
Small holdings, annual report, 1914	73
Special Enquiries Branch, report for first 12 months of war	833
Sulphate of ammonia, need for increased purchase by farmers	1180, 1267, 1309
" Parliamentary Secretary's letter to "Times"	
as to exports	1016
Swine fever, Board's scheme for treatment by serum injection	591, 691, 702
" final report of committee	690
" slaughter of pigs	702
Tithe, etc., Acts, report of proceedings under, 1914	281
" maps, alteration in facilities for examination	1019
Transport of goods by rail	811
Walker, Colonel Hall, purchase of land by the Government	911
War agricultural committees	702, 861, 907, 1013, 1015, 1186
War notices, etc., see <i>War and Agriculture.</i>	
Wart disease of potatoes, suitable varieties for infected areas	813
Board of Trade:	
Agricultural labourers and enlistment	87
Labour Exchanges and the war	178, 179
Wages of agricultural labourers, increase in	374
Women, notices as to war work	472, 474
Bog land, reclamation by manuring and crop growing (<i>Ireland</i>)	897
Book-keeping, methods of farm valuation	1215
Bordeaux Mixture, see <i>Spraying.</i>	
Botanic gardens, Kew, charges for admission	1019
Bracken, use as litter	680, 699
Bran, use for feeding purposes	290, 1132, 1301
Brazil: Agriculture and live stock in	1295
Bread making from buckwheat	1131
" rice flour (<i>France</i>)	465

	PAGE
Breeding (see also <i>Live Stock</i>) :	
Black currants and pears, experiments in crossing	252
Foundling variety of hop	136
Hereditary twinship in sheep (U.S.)	1178
Pollination of fruit trees	418
Sheep crossing experiment (<i>Harper Adams</i>)	163
Brewers' grains, use for feeding purposes	300, 301, 1301
British Association (see also specific subjects of papers read) :	
Presidential address on food supplies in time of war	504
Systems of farming and the need for more tillage	520
British Columbia, see <i>Canada</i> .	
British Flax and Hemp Growers' Society, Limited : Linseed as a farm crop	1069
Brooks, F. T. : Experiments on American gooseberry mildew in Cambridge-shire	227
Brown, E. : Combination in poultry-keeping	326
Laying competition at Burnley	658
Report on the poultry industry in Wales, <i>Journal supplement</i>	694
"Brown Oak," a disease of oak trees	902
Buckwheat, growth, composition and uses	28, 1128
Burgundy mixture, see <i>Spraying</i> .	
Burnley egg-laying competition	658
Butter, see <i>Dairying</i> .	
Cabbages, manuring	1272
time of sowing (<i>Chelmsford</i>)	266
Calcium carbide residue for liming	... 699, 1289
Calcium cyanamide, see <i>Manures</i> .	
Calico poultry-houses	969, 1140
Cambridge University : Monthly notes on feeding stuffs	52, 148, 248, 322, 456,
	574, 680, 792, 887, 1001, 1149, 1276
Use of straw for fodder	663
Campbell, Colin, speech at food supply meeting	503
Canada : Agricultural budget for 1915-16	377
	credit in British Columbia
Deputation to the Board as to importation of Canadian cattle	590
Medicinal plants, cultivation	913
Weed control acts and methods	184
Carriage by rail of agricultural produce	177, 781, 811, 1260
Castor oil seeds, poisoning of stock by (<i>Germany</i>)	359
Cattle, see <i>Live Stock</i> .	
Cereals, see <i>Corn</i> and specific crops.	
Chalk, see <i>Lime</i> .	
Cheese, see <i>Dairying</i> .	
Chickens, see <i>Poultry</i> .	
Cider, see <i>Fruit—Apples</i> .	
Clover : Clustered clover seed as an adulterant of white clover seed	253
Crimson clover, growth	30
Leys, improvement by increased sowing of clover	1110
Manuring (<i>E. Suffolk, C. C.</i>)	162
Mixtures of clover and grass seed	356, 997
Quality of seed of red, white and alsike clover, 1912-1914	1044
White clover seed, adulteration	253, 997
Wild white clover	1063
Cocksfoot, report on quality of seed, 1912-1914	1050
Coco-nut cake, use as a feeding stuff	304, 740
Collinge, W. E. : A preliminary report upon the economic status of the British species of woodpeckers and their relation to forestry	789
Collins, S. H. : The feeding of linseed to calves	120
Commercial Control Branch of the Board, reports for 1914 and 1915	374, 1259
Commissions and Committees :	
Agricultural consultative committee	178
Development Commission, see <i>Development Fund</i> .	
Fertilisers, committee to control supplies	811, 1015, 1180
Home-grown timber committee	1019
Home production of food, committee on	370, 494, 585, 803
Horses, committee on supply for military purposes	590, 1022, 1253
Indian wheat committee	180, 372
Labour committees to deal with shortage	179
Land settlement for discharged soldiers and sailors, committee to consider	469, 813, 1166, 1188

Commissions and Committees— <i>continued.</i>					PAGE
Sewage disposal, final report ...	...	...	...	...	235
Swine fever, final report of committee ...	...	...	...	...	690
War agricultural committees ...	...	702, 861, 907, 1013, 1015, 1186	...	...
<i>Australia</i> , export of meat commission, report ...	...	...	...	...	460
Common, grazing in ...	...	...	...	...	1291
Compensation, farm valuations for book-keeping purposes ...	...	...	...	...	1215
Conferences and Congresses:					
Agricultural education conference, report on agricultural education for women ...	...	...	...	...	859
Co-operation and Credit:					
Allotments, co-operation in ...	...	...	...	...	961
Cattle insurance societies in 1913 ...	...	...	...	...	273
Co-operative credit associations in 1913 ...	...	...	...	...	273
Croydon vacant lands cultivation society ...	...	...	...	...	963
Development Commissioners' report for 1914-15 on grants ...	...	...	...	...	1175
Distributive societies in 1913 ...	...	...	...	...	270
Farm implement societies ...	...	...	...	413, 570, 784	
Haddenham cattle insurance society ...	...	...	...	...	694
Hitchin bacon factory ...	...	...	...	...	317
Live stock breeding and improvement associations ...	...	...	...	...	46
Milk supply, organisation on co-operative lines ...	...	...	...	...	1307
Monographs on agricultural co-operation: Vol. II., issue by International Institute of Agriculture ...	...	...	...	...	370
Pig insurance societies in 1913 ...	...	...	...	...	273
Poultry keeping, co-operation in ...	...	...	...	...	327
Productive societies in 1913 ...	...	...	...	...	270
Selling by co-operative methods, suggestions from America ...	...	...	...	201, 370	
War food societies ...	...	...	...	407, 894, 909	
Women farmers' co-operative societies ...	...	...	...	...	637
<i>Canada</i> , agricultural credit in British Columbia ...	...	...	...	...	274
<i>France</i> , co-operative agricultural credit in 1913 ...	...	...	...	...	74
<i>India</i> , co-operative agricultural credit in the Punjab ...	...	...	...	...	368
<i>Italy</i> , Ferentino co-operative cattle insurance society ...	...	...	...	...	170
<i>South Africa</i> , land and agricultural bank ...	...	...	...	...	365
<i>United States</i> , the Watsons fruit growers' association ...	...	...	...	...	367
Copper salts, influence on wheat (<i>Woburn</i>) ...	...	...	...	...	464
Corn (see also <i>Crops</i> , <i>Wheat</i> , etc.):					
Acreage and produce in 1914 ...	...	...	...	99, 506, 509	
1915 ...	...	...	...	701, 817, 1189	
Grain, purchase by Government ...	...	...	...	...	1013
Growth of two white-straw crops in succession ...	...	...	...	...	533
Imports of grain in the cereal year ...	...	...	...	...	579
Manuring corn crops in spring of 1916 ...	...	...	...	...	1274
Ofals, utilisation for feeding purposes ...	...	...	...	297, 1132	
Prices, annual averages, 1909-15 ...	...	...	...	...	1037
Stubbles, use for feeding poultry ...	...	...	...	...	678
Cowgrass, report on quality of seed, 1912-14 ...	...	...	...	...	1046
Credit, see <i>Co-operation</i> and <i>Credit</i> .					
Crops (see also specific crop, <i>Rotations</i> , <i>Agricultural Returns</i> , etc., "Agricultural Conditions in England and Wales," and "Notes on Crop Prospects Abroad" in each issue):					
Bare follows, need for reducing ...	...	...	...	...	1292
Catch crops and home-grown feeding stuffs ...	...	...	...	23, 266, 653	
Continuous green cropping ...	...	...	...	...	31
Decline in the agricultural area of England and Wales ...	...	...	...	...	475
Growth of two white-straw crops in succession ...	...	...	...	...	533
Maintenance of production during the war ...	...	...	...	...	182
Systems of farming and the production of food ...	...	...	...	...	320
Valuation of crops for book-keeping purposes ...	...	...	...	...	1218
<i>Ireland</i> , area under crops, 1915 ...	...	...	...	...	465
<i>Scotland</i> , area under crops, 1915 ...	...	...	...	...	468
Crowther, C.: Dried yeast as a food for farm stock ...	...	...	...	...	1
Croydon vacant lands cultivation society ...	...	...	...	...	963
Cumberland and Westmorland travelling butter-making school ...	...	...	...	...	1008
Dairying:					
Butter: Churning, methods of treatment of cream ...	...	...	...	...	359
Cumberland and Westmorland travelling butter-making school ...	...	...	...	...	1008
Mouldiness in butter (<i>U.S.</i>) ...	...	...	...	...	163

Dairying— <i>continued</i> —		PAGE
Calf rearing	.. .. .. .. ..	163, 361, 768
Cheese: Comparison of cheese-making with other methods of using milk	.. .. .. .. ..	677
Rennet, preparation of home-made extract	.. .. .. .. ..	241
Commercial Control Branch of the Board, reports for 1914 and 1915	374, 1259	
Dairy Cattle: Conformation of cows and milk yield (<i>Germany</i>)	.. .. .. .. ..	266
Feeding, see <i>Feeding Stuff</i> .		
Milk recording certificates of the Board, value	.. .. .. .. ..	1292
Milk:		
Bacteria, destruction by electricity	.. .. .. .. ..	1229
Bacterial content, effect of condensing and drying the milk	.. .. .. .. ..	267
Churning, methods of treatment of cream	.. .. .. .. ..	359
Clotted cream	.. .. .. .. ..	105
Colon bacilli, ability to survive pasteurisation (<i>U.S.</i>)	.. .. .. .. ..	268
Comparison of milking twice or three times daily (<i>Durham C.C.</i>)	.. .. .. .. ..	1305
Conformation of cows and milk yield (<i>Germany</i>)	.. .. .. .. ..	266
Cost of food in milk production (<i>Yorkshire</i>)	.. .. .. .. ..	1177
Cost of production in war time	.. .. .. .. ..	981
winter feeding in milk production	.. .. .. .. ..	841
Factors of importance in milking	.. .. .. .. ..	899
Feeding for winter milk (<i>E. Sussex</i>)	.. .. .. .. ..	70
Freezing point of milk as a test for added water	.. .. .. .. ..	267
Goat as a source of milk	.. .. .. .. ..	642
Grass land of good quality for milk production	.. .. .. .. ..	524
Manuring of grass land for milk (<i>Harper Adams</i>)	.. .. .. .. ..	262
Milking machines	.. .. .. .. ..	36, 73, 358
Milk recording societies, grants under the Board's scheme	.. .. .. .. ..	49
Value of Board's certificate	.. .. .. .. ..	1292
Onion flavour, removal from milk (<i>U.S.</i>)	.. .. .. .. ..	268
Organisation of the milk supply	.. .. .. .. ..	1307
Sale of milk, circular letter as to hardship in conforming with		
Sale of Food and Drugs Acts	.. .. .. .. ..	908
Time of milking, effect on quantity and quality (<i>Durham C. C.</i>)	.. .. .. .. ..	1305
Women, education and openings in dairy work	.. .. .. .. ..	628
<i>Denmark</i> , progress of the dairy industry	.. .. .. .. ..	124
Denmark: Investigations showing how tubercular fowls infect pigs	.. .. .. .. ..	41
Progress of the live stock, dairy and poultry industries	.. .. .. .. ..	122, 478
Development Fund: Live stock breeding and improvement, Board's scheme	.. .. .. .. ..	46
Report of Development Commissioners for 1914-15	.. .. .. .. ..	1172
Diseases of Animals and Veterinary Science (Diseases of Poultry, see <i>Poultry</i>):		
Animals Division of the Board, report for 1914	.. .. .. .. ..	87
Bacillary necrosis of the liver in unborn lambs (<i>Wye</i>)	.. .. .. .. ..	165
Chief veterinary officer's report for 1914	.. .. .. .. ..	700, 704
Foot-and-mouth disease outbreaks	.. .. .. .. ..	814, 910, 1021, 1179, 1308
Husk or hoose in calves	.. .. .. .. ..	662
Parasitic mange amongst east army horses, circular letter...	.. .. .. .. ..	700
cacao shells (<i>Germany</i>)	.. .. .. .. ..
Poisonous properties of castor oil seeds (<i>Germany</i>)	.. .. .. .. ..	359
Rabies in an imported dog	.. .. .. .. ..	177
Slaughter of animals order of 1915	.. .. .. .. ..	370
Spread of disease from army horses to agricultural horses	.. .. .. .. ..	1188
Swine fever, Board's scheme for treatment by serum injection	.. .. .. .. ..	594, 691, 702
final report of committee	.. .. .. .. ..	690
slaughter of pigs, reduction in	.. .. .. .. ..	702
Tuberculosis, destruction of bacteria in milk by electricity	.. .. .. .. ..	1229
prevalence among pigs in Great Britain	.. .. .. .. ..	704
transmission from fowls to pigs	.. .. .. .. ..	41
<i>South Africa</i> , inoculation of cattle in Rhodesia against the plasmoses..	.. .. .. .. ..	476
Diseases of Plants (see also <i>Insects and Fungi</i>):		
Horticulture Branch of the Board, report for 1914-15	.. .. .. .. ..	931
Smoke, effect on plant growth (<i>Leeds</i>)	.. .. .. .. ..	168
<i>France</i> , establishment of plant diseases branch of Ministry of Agriculture	.. .. .. .. ..	476
Distillers' grains, use for feeding purposes	.. .. .. .. ..	300, 301, 1301
Down grazings, enclosing with wire fencing	.. .. .. .. ..	721
Drug plants, collection and sale in England	.. .. .. .. ..	62
cultivation in Canada	.. .. .. .. ..	913

	PAGE
Dunne, J. J. : Danish investigations showing how tubercular fowls infect pigs	41
Progress of the live stock industry in Denmark	122
Earth-nut, see <i>Ground-nut</i> .	
Edge, S. F. : Waste woodland for the breeding of pigs	977
Education :	
Agricultural education conference, report on agricultural education for women	859
Cumberland and Westmorland travelling butter-making school	1008
Cream memorial prize	276
Development Commissioners' report for 1913-15	1172
Grants for agricultural education and research, regulations for 1915-16	65
" " " report for 1914-15	708
Poultry management, short course at South Eastern Agricultural College	475
Sailors and soldiers, discharged, training of	813
Technical advice for farmers	37
Women, education and openings in horticulture and agriculture	554, 616
Eggs, see <i>Poultry</i> .	
Electricity, destruction of milk bacteria by	1229
Ensilage : Maize ensilage	688
Preparation of silage	341
Silage as food for stock	1249
Special notice to farmers	372
Sugar beet crowns and leaves	737
Exhibitions and Shows : London thoroughbred stallion show, 1916	907
Panama-Pacific international exhibition, 1915, live stock section	283
Experiments, see specific subject.	
Export regulations, see <i>Import and Export Regulations</i> .	
Exports, see <i>Imports and Exports</i> .	
Eyre, J. Vargas : A new fungicide for use against American gooseberry-mildew	1118
Falkner, Lt.-Col. P. H. : Calico poultry-houses	969
Fallows, need for reducing	1292
Feeding and Feeding Stuffs (Poultry feeding, see <i>Poultry</i>) :	
Acorns	686, 902
Apple pomace	811, 855
Beans	305
Bran	293, 1132, 1301
Brewers' grains	300, 301, 1301
Buckwheat	1132
Bullocks, winter feeding (<i>Canada</i>)	1302
Cake feeding, manurial value (<i>Woburn</i>)	353
Calf feeding (<i>Harper Adams</i>)	163
(<i>Woburn</i>)	361
" rearing	768
Castor oil seeds, poisoning by (<i>Germany</i>)	359
Catch crops, suggestions for cultivation	23, 266, 653
Cattle, store, feeding in winter (<i>U.S.</i>)	71
Cereal oilseeds	297
Cereal oils	304, 740
Coconut cake	1259
Commercial Control Branch of the Board, reports for 1914 and 1915	374, 1259
Comparative values of feeding stuffs	52, 148, 248, 322, 458, 574, 689, 792, 887, 1091, 1149, 1276
Corn feeding, manurial value (<i>Woburn</i>)	333
Dairy cows, fattening of unprofitable animals (<i>Wye</i>)	164
" feeding for winter milk (<i>E. Sussex</i>)	70
Distillers' grains	300, 301, 1301
Earth-nut, see <i>Ground-nut</i> .	
Fertilisers and Feeding Stuffs Act, 1906, facilities for sampling and analysis	702
Fibre content, value in concentrated foods	899
Fish as cattle food (<i>India</i>)	70
Fish meal	305
Flax shives (<i>U.S.</i>)	268
Fodder, suggestions for increasing the amount	453
Forage crops, use for pig feeding	133

Feeding and Feeding Stuffs— <i>continued</i> .		PAGE
Gluten meal and gluten feed	...	269, 302
Gorse	...	455
Grasses, various (<i>Germany</i>)	...	1304
Ground-nut cake	...	308, 740, 875
" meal for dairy cows (<i>France</i>)	...	269
Hempseed cake	...	1304
Home-grown feeding stuffs, suggestions for cultivation	...	23, 266, 653
Litseed feeding for calves	...	120
" growth for feeding purposes	...	29, 1069
Maize germ meal	...	303
" gluten feed for dairy cows (<i>France</i>)	...	269
Malt culms	...	239, 302
Manioc meal for dairy cows (<i>France</i>)	...	269
Middlings	...	300
Milk production, cost of winter feeding	...	841
" feeding, etc., in war time	...	981
" food (<i>Yorkshire</i>)	...	1177
Niger seed and cake	...	874
Palm-nut kernel cake	...	305, 738, 998
Phosphate, effect on yield and quality of milk	...	1305
Phosphorus requirements of lambs (<i>U.S.</i>)	...	1178
Pig feeding (<i>U.S.</i>)	...	70
" and rearing in waste woodland	...	977
" in Ireland, advice as to	...	351
" on forage crops	...	153
" on straw (<i>Germany</i>)	...	1303
" with uncooked meals (<i>Cockle Park</i>)	...	1303
Pomace from cider and perry making	...	811, 851
Potato tops	...	454
Railway transport	...	811, 1260
Reeds	...	454
Rice meal	...	303
Safflower seed and cake	...	875
Seaweed	...	1106
Sesame seed and cake	...	871
Sharps	...	300
Silage	...	341, 372, 688, 757, 1249
Soya bean, cake and meal	...	304, 1286
Starch equivalent theory	...	794
Stirks, winter feeding (<i>Cockle Park</i>)	...	1302
Straw, composition and digestibility (<i>Germany</i>)	...	900
Straw as fodder	...	453, 663, 1303
Sugar beet crowns and leaves	...	750
Unit prices of feeding stuffs	52, 148, 248, 322, 456, 574, 680, 702, 887, 1001, 1149, 1276	
War, influence on supplies and use of feeding stuffs	...	737
Weeds, feeding value of certain species (<i>Germany</i>)	...	362
Wheat offals, composition	...	260
White mustard	...	25, 454, 1134
Yeast, dried	...	1, 302, 740
<i>Guernsey</i> , prevention of fraud in sale of feeding stuffs	...	915
Fencing, cost and methods of enclosing Downland with wire	...	721
Ferentino co-operative cattle insurance society	...	170
Fertilisers, see <i>Manures</i> .		
" Feuillette" flax retting process (<i>France</i>)	...	169
Fish : Cattle feeding on fish (<i>India</i>)	...	70
" Meal, utilisation a feeding stuff	...	305
" Mussels as manure	...	156
Flax (see also <i>Linseed</i>) :		
Development Commissioners' report for 1914-15 on grants	...	1174
Feeding value of flax shives (<i>U.S.</i>)	...	268
" Feuillette" process of retting (<i>France</i>)	...	169
Liming (<i>Ireland</i>)	...	355
Manuring (<i>Ireland</i>)	...	355
Varieties (<i>Ireland</i>)	...	354
Food supply during war time, see <i>War and Agriculture</i> .		
Food value of different kinds of produce	...	527
Forbes, Miss E. H. : Essay on the way in which women can assist agriculture, and the increased production of food during the war	...	929

Forestry (see also <i>Insects</i> and <i>Fungi</i>) :	PAGE
Acorns, use as food for stock ...	686
" bad effect on laying hens (<i>Germany</i>) ...	902
Advice in forestry ...	40
" " Brown Oak," a disease of oak trees ...	902
Development Commissioners' report for 1914-15 on grants ...	1175
Home-grown timber committee ...	1019
Larch plantations in Ireland ...	231
Pig rearing in waste woodland ...	977
Rest period in plants (<i>U.S.</i>) ...	1179
Toxic effect of grasses and weeds around young trees ...	1178
Willow-growing and basket making ...	1081
Wood ash as a source of potash ...	146, 766
Woodpeckers and their relation to forestry ...	789
<i>Dendrocoptes major</i> and <i>minor</i> ...	789
<i>Geocinus viridis</i> ...	789
<i>Salix purpurea</i> , <i>S. triandra</i> and <i>S. viminalis</i> ...	1081
Fowls, see <i>Poultry</i> .	
Foxes, need and methods for destruction ...	815, 1165
Foxtail, report on quality of seed, 1912-14 ...	1051
France : Co-operative agricultural credit in 1913 ...	74
Plant diseases branch of Ministry of Agriculture, establishment ...	476
Fream memorial prize ...	236
Frost, protection of fruit against (<i>Canada</i>) ...	71
Fruit (see also <i>Crops</i> , <i>Insects</i> , <i>Fungi</i> , <i>Spraying</i> , <i>Breeding</i> and <i>Import Regulations</i>) :	
Apples : Cider acetification ...	939
" blackening ...	167, 948
" disorders and methods of combating ...	939
" oiliness and ripeness ...	946
" sickness ...	166, 944
" sweetening (<i>Bristol</i>) ...	167
Pomace as a feeding stuff ...	811, 855
Spraying <i>v.</i> dusting against apple scab ...	270
Black currants, experiments in crossing ...	252
Farm orchards of Herefordshire ...	892
Frost, protection from (<i>Canada</i>) ...	71
Pears :	
Experiments in crossing ...	252
Perry disorders and methods of combating ...	939
Pollination of fruit trees, observations and experiments ...	418
Pomace from cider and perry making, composition and uses ...	811, 851
Preserving for small market growers or for domestic use ...	447
Pulp, making of ...	450
Railway transport ...	782, 1261
Storage of apples and pears ...	697, 814
United States, the Wathena fruit growers' association ...	367
Fryer, J. C. F. : Capsid bugs ...	950
Notes on lime washes ...	1125
Fungi (see also <i>Diseases of Plants</i> and <i>Spraying</i>) :	
American gooseberry mildew, experiments in preventing ...	227, 364, 1118, 1244
" Orders of 1915 ...	276, 279
" " warning ...	177
Apple scab (<i>U.S.</i>) ...	270
" " Brown Oak," a disease of oak trees ...	902
Brown scab of potatoes (<i>Ireland</i>) ...	363
Celery leaf-spot ...	1119
Hop mildew ...	931
Horticulture Branch of the Board, report for 1914-15 ...	363
Iris leaf-blotch disease ...	269, 270
Potato blight (<i>Ireland</i>) ...	699
" disease ...	269
Stalk or sclerotium disease of potatoes (<i>Ireland</i>) ...	364
Wart disease of potatoes (<i>Scotland</i>) ...	813
varieties suitable for infected areas ...	363
<i>Helcosporium gracile</i> ...	699
<i>Phytophthora infestans</i> ...	147, 227, 256, 279, 364, 1118, 1244
<i>Spharotheca mosi-urae</i> ...	1119
" <i>humili</i> ...	

		PAGE
Fungi—continued.		
<i>Synchitrium endobioticum</i>	...	361, 813
France, establishment of plant diseases branch of Ministry of Agriculture	...	476
Gardening, (see also <i>Small Holdings and Allotments</i>):		
education and openings for women	...	551, 616
Garrad, G. H. : Cost of winter feeding in milk production	...	841
Genetics, see <i>Breeding</i> .		
Germany : Agriculture and the war	...	741
Karakul sheep breeding centre near Leipzig	...	283
Germination of barley seed, conditions affecting	...	313
seeds, method of testing	...	364
Gilchrist, D. A. : Trials of wild white clover	...	1063
Girmingham, C. T. : The use of pressed apple pomace	...	851
The waste from saw-mills as a source of potash	...	146
Gluten meal and gluten feed, use for feeding purposes	...	299, 302
Goat as a source of milk	...	642
Golf links, grazing by sheep	...	177, 373
Goodall, A. A. : The breeding of utility pigeons	...	335
Gorse, use as fodder	...	455
Grain, see <i>Corn</i> and specific crops.		
Grass, see <i>Pasture</i> .		
Gray, R. A. H. : The prevention of egg-laying on turnips by the diamond-back moth	...	222
Green manuring	...	353, 355, 1134
Ground nut cake, use as a feeding stuff	...	308, 740, 875
meal as a food for dairy cows (<i>France</i>)	...	269
Grove, O. : Disorders of cider and perry	...	939
Guano, imports in 1914	...	377
Guerney, sale of fertilisers and feeding stuffs act, 1915	...	915
Haddenham cattle insurance society	...	694
Hallan, E. T. : Influence of the war on supplies and use of feeding stuffs	...	737
Harper Adams College, egg-laying competitions of the Utility Poultry Club	...	594, 808, 1306
Harvest weather forecasts, supply by Meteorological Office in 1915	...	178
Hay (see also <i>Pasture</i>) :		
Acreage and produce in 1914	...	90
1915	...	701, 817, 1189
Influence of manure on crop and soil (<i>Garforth</i>)	...	1176
Manuring (<i>Chelmsford</i>)	...	162
" (<i>Harper Adams</i>)	...	263, 264
" (<i>Ireland</i>)	...	161
" (<i>Rothamsted</i>)	...	358
of grass land	...	542
Natural and artificial drying of grass (<i>Germany</i>)	...	364
Production for the Army	...	183, 471
Rye-grass, varieties (<i>Woburn</i>)	...	357
Storage, effect on composition and digestibility (<i>Germany</i>)	...	363
Hempseed cake for dairy cows	...	1304
Hendrick, J. : The manorial situation and its difficulties	...	609
Composition and use of certain seaweeds	...	1095
Herefordshire, description of farm orchards	...	892
Hitchin bacon factory	...	317
Home production of food during war time, see <i>War and Agriculture</i> .		
Hops :		
Acreage and produce in 1914	...	90
1915	...	595, 816, 1189
A new variety of hop—the "Foundling"	...	136
Manuring	...	260
Horses, see <i>Live Stock</i> .		
Horticulture (see also <i>Fruit, Vegetables, Fungi, Insects and Spraying</i>) :		
Horticulture Branch of the Board, report for 1914-15	...	931
Women, education and openings in horticulture	...	554
Hudson, Miss E. L. : The Croydon vacant lands cultivation society	...	983
Hutchinson, H. P. : Willow-growing and basket-making as rural industries	...	1081
Imms, A. D. : Notes on beet or mangold fly	...	881
Implements, see <i>Machinery</i> .		

Import and Export Regulations :	PAGE
Export of sulphate of ammonia	1076
<i>Argentina</i> , live stock	378, 906
Lucerne seed and seed of forage plants	915
<i>Australia</i> , cattle	1025
<i>Bermuda</i> , live stock and fodder	233
<i>Canada</i> , live stock	284
<i>India</i> , regulation of exportation of wheat	180, 372, 1013
<i>Ireland</i> , cattle	698
<i>Jersey</i> , forage	1025
<i>New Zealand</i> , live stock	906
Plants	1024
<i>Russia</i> , live stock	1295
Imports and Exports :	
Exports, agricultural, in 1915	1160
Grain, imports in the cereal year, 1914-15	579
Imports of agricultural produce	514, 519, 986
Special Enquiries Branch, report on first twelve months of war	833
Wheat, average prices during 1913-1915, and countries from which received	1037
<i>Australia</i> , commission of enquiry into meat export trade, report	460
<i>Canada</i> , deputation to the Board as to importation of Canadian cattle	590
<i>India</i> , regulation of exportation of wheat	180, 372, 1013
Index number for comparing prices of agricultural produce in different years	911
India : Co-operative agricultural credit in the Punjab	368
Regulation of the exportation of wheat	180, 372, 1013
Inoculation (see also <i>Bacteriology, Diseases of Animals, etc.</i>) :	
Peat, inoculation of crops with a preparation of (<i>Woburn</i>)	464
(<i>Midland</i>)	1297
Serum injection for treatment of swine fever	594, 601, 702
<i>South Africa</i> , inoculation of cattle in Rhodesia against the plasmoses	476
Insects (see also <i>Bees and Spraying</i>) :	
Beet fly	881
Capsid bugs	950
Diamond back moth	222
Horticulture Branch of the Board, report for 1914-15	921
Larch-shoot moths	50
Mangold fly	881
Turnip gall weevil	884
Wireworms, attack on a barley crop	313
<i>Argyresthia alnivorella</i> , <i>A. laevigatella</i> , and <i>A. zellerella</i>	50
<i>Atractotomus mali</i>	950
<i>Ceuthorynchus plectrostigma</i> and <i>C. sulcicollis</i>	884
<i>Lugus pratensis</i>	950
<i>Orthotylus marginalis</i>	950
<i>Pegomyia bicolor</i> and <i>P. nigritarsis</i>	883
<i>Pegomyia hyoscyami</i>	881
<i>Plesiocoris rugicollis</i>	950
<i>Ptinella maculipennis</i>	224
<i>Psyllus ambiguus</i>	950
Insurance : Co-operative insurance, see <i>Co-operation and Credit</i> .	
National Insurance Act, 1911, regulations under	700
International Institute of Agriculture (for report on Crop Prospects see summary in each issue).	
Bulletin of agricultural and commercial statistics	377
Financial statement for 1914	63
Monographs on agricultural co-operation ; Vol. II., issue of	370
Proceedings of the permanent committee	350
Relations with tropical and colonial agriculture	65
Third year-book of agricultural statistics	815
Ireland : Area under crops, 1915	588
Committee on home production of food, report	231
Larch plantations in the Galtee mountains	466
Number of live stock, 1915	244
Pig breeding industry	462
Seaweed cultivation for manure	791
Italy : Ferentino co-operative cattle insurance society	170

Live Stock—continued.	PAGE
Mares for breeding, sale after use by the Army	277
Stallions, London thoroughbred show, 1916	906
Walker, Colonel Hall, purchase of stud by the Government	911
Improvement of live stock, breeding associations	46
" " Development Commissioners' report for 1914-15 on grants	1174
Improvement of live stock, report on administration of grant, 1914-15	706
Index number for comparing prices of live stock in different years	911
Insurance, see <i>Co-operation and Credit</i> .	
Live stock officers	40
Maintenance of live stock: notice as to, and Act and Order of 1915	182, 275,
" " " 468, 591, 1018	
Number of live stock in England and Wales, 1915	597
" " the United Kingdom, 1914	90, 509
" " 1915	701, 1189
Pigs: Boars, grants for breeding and improvement	48
Clubs, see <i>Co-operation and Credit</i> .	
Feeding, see <i>Feeding Stuffs</i> .	
Fluctuations in weight of newly-born pigs (<i>Germany</i>)	266
Hitchin bacon factory	317
Irish pig breeding industry	244
Pigmentation of bacon (<i>Cambridge</i>)	1304
Waste woodland for rearing pigs	977
Sheep: Fat lambs from Welsh crosses (<i>Harper Adams</i>)	163
Feeding, see <i>Feeding Stuffs</i> .	
Grazing on golf links	177, 373
Hereditary twinship (<i>U.S.</i>)	1178
Karakul sheep	283, 434
Lambs, fluctuations in weight after birth (<i>Germany</i>)	266
Manuring for mutton (<i>E. Suffolk C. G.</i>)	161
Slaughter of animals, notice as to, and Order of 1915	182, 370, 468, 469, 702
Valuation of stock for book-keeping purposes	1219
Brazil, methods of live stock improvement	1294
Canada, deputation to the Board as to importation of Canadian cattle	590
Denmark, progress of the live stock industry	122, 478
Germany, Karakul sheep breeding centre near Leipzig	283
Ireland, pig breeding industry	244
Number of live stock, 1915	466
Scotland, number of live stock, 1915	467
United States, Panama-Pacific International Exhibition, 1915, live stock section	283
London thoroughbred stallion show, 1916	907
Lucerne:	
Varieties (<i>Chelmsford</i>)	265
" (<i>Woburn</i>)	356
Machinery: Co-operative farm implement societies	413, 570, 784
Disc harrows	784
Labour supply and machinery	33
Milking machines	36, 73, 358
Motor ploughs and tractors	34, 413, 570, 709, 784
Rail transport delay	177, 781, 1280
Valuation for book-keeping purposes	1224
Magnesia, effect on wheat and mangolds (<i>Woburn</i>)	464
relation to lime in soils	353
Maintenance of Live Stock Act, 1915	468
" Order, 1915	275, 591, 1018
Maize: Germ meal, for feeding purposes	303
Gluten feed for dairy cows	269, 302
Growth	28
" (<i>Chelmsford</i>)	265
Methods of using green maize	688
Malden, W. J.: Notes on machinery and the labour supply	33
Malt culms, use as a feeding stuff	239, 302
Manganese as manure	806, 1297
Mangolds: Acreage and produce in 1914	90
" 1915	701, 910, 1180

Mangolds— <i>continued.</i>	PAGE
Germination (<i>Harper Adams</i>) ...	357
Magnesia, effect on growth (<i>Woburn</i>) ...	464
Manuring (<i>Chelmsford</i>) ...	256
" (<i>Hereford Educ. Com.</i>) ...	257
" (<i>Midland</i>) ...	1301
" (<i>Rothamsted</i>) ...	357
Salt in place of potash ...	402
Seed, report on quality, 1912-1914 ...	1049
Top-dressing (<i>Harper Adams</i>) ...	357
Varieties (<i>Chelmsford</i>) ...	256
" (<i>Harper Adams</i>) ...	358
" (<i>Midland</i>) ...	1301
Manioc meal as food for dairy cows (<i>France</i>) ...	269
Manures (see also specific crops):	
Ashes for production of potash ...	146, 766
Basic slag, time at which to apply to grass land ...	1013
valuation of phosphate content ...	897
Cake and corn, comparison of manurial values (<i>Woburn</i>) ...	353
Calcium carbide residue for liming ...	699, 1289
Commercial Control Branch of the Board, reports for 1914 and 1915 374, 1259	
Compound manures, suggestions for mixing ...	675
Copper salts, effect on wheat (<i>Woburn</i>) ...	464
Corn and cake, comparison of manurial values (<i>Woburn</i>) ...	353
Farmyard manure, bracken, use for making dung ...	689, 699
" composition, storage and application ...	131, 158, 1270
" effect of straw on the utilisation of nitrogen (<i>Austria</i>) 157	
Fertilisers and Feeding Stuffs Act, 1906, facilities for sampling and analysis ...	762
" committee to control supplies ...	811, 1015, 1180
" monthly notes on prices and values ...	1156, 1281
" need for increased use in Wales ...	1263
Green manuring ...	353, 355, 1134
Guano, imports in 1914 ...	377
Humus, soluble, effect on productiveness of soil ...	1298
Lead salts, influence on wheat (<i>Woburn</i>) ...	464
Lime, application to soil rich in magnesia (<i>Woburn</i>) ...	353
" for sterilisation and neutralisation of soils ...	255, 353
" substituted for potash for leguminous crops ...	404
Liquid manure ...	346, 1273
Magnesia, effect on wheat and mangolds (<i>Woburn</i>) ...	464
Manganese (<i>Germany</i>) ...	806
" sulphate (<i>Midland</i>) ...	1297
Manurial situation and its difficulties ...	609
Mussels ...	156
Niger cake ...	874
Nitrate of lime ...	1296
Nitrate of soda, imports in 1914 ...	377
" shipment from Chile ...	1018
Nitrogenous manures, supply in war time ...	612
tests with various kinds (<i>Germany</i>) ...	159
Nitrolim, granular ...	1287, 1296
Peat, bacterised (<i>Midland</i>) ...	1297
" (<i>Woburn</i>) ...	464
" moss litter manure (<i>Germany</i>) ...	158
Phosphate, value of soluble and insoluble in basic slag ...	897
Phosphates, mineral, imports in 1914 ...	377
Phosphatic manures, supply in war time ...	613
manuring as a means of accumulating fertility in grass land ...	1201
Phosphoric acid, citric soluble, production and value (<i>U.S.</i>) ...	68
Pomace from elder and perry making ...	851
Potash, from ashes ...	146, 766
" production and value (<i>U.S.</i>) ...	68
" shortage caused by the war ...	393, 614
" substitutes ...	68, 400, 402, 404
" supply of the world ...	672
Radio-active manure (<i>Germany</i>) ...	806
" (<i>U.S.</i>) ...	68, 354, 806
Railway transport ...	1260

Manures—continued.		PAGE
Salt as a substitute for potash...	...	68, 402
Saw-mill waste as a source of potash...	...	146
Seaweed ...	...	462, 1095
Sesame cake ...	...	873
Sewage sludge ...	...	235
Sugar beet crowns and leaves ...	...	750
Sulphate of ammonia (<i>France</i>) ...	...	1297
" " need for increased purchase by farmers	1180, 1267, 1309	
" " Parliamentary Secretary's letter to "Times"		
as to exportations ...	...	1016
Sulphur (<i>Germany</i>) ...	...	376
" " production and quality in 1914 ...	...	354
Superphosphate, purchase of ...	...	1270
Supplies of fertilisers, appointment of committee ...	...	811
Weeds, manorial value of certain species (<i>Germany</i>) ...	...	362
<i>Guernsey</i> , prevention of fraud in sale of fertilisers ...	...	915
Market gardening, see <i>Small Holdings and Allotments</i> .		
Markets : Co-operative selling and the use of trade marks ...	...	201, 370
Railway transport of agricultural produce ...	177, 781, 811, 1260	
Special Enquiries Branch, report on first twelve months of war ...	...	833
United States, the Watauga Fruit Growers' Association ...	...	367
Meadows, see <i>Pasture and Hay</i> .		
Meat : Beef, manuring for (<i>Harper Adams</i>) ...	...	262
Black discolouration of bacon (<i>Cambridge</i>) ...	...	1304
Hitchin bacon factory ...	...	317
Maintenance of live stock, notice as to, and Act and Order of 1915 ...	182, 275,	
" " ...	468, 591, 1018	
Mutton, manuring for (<i>E. Suffolk C.O.</i>) ...	...	161
Production on grass and arable land ...	...	521, 525
Slaughter of Animals Order of 1915 ...	182, 370, 408, 469, 702	
Supplies during war, measures taken by Special Enquiries Branch ...	...	839
Australia, commission of enquiry into meat export trade, report ...	...	460
Ireland, pig breeding industry ...	...	244
Medicinal plants, collection and sale in England ...	...	62
cultivation in Canada ...	...	913
Mendelism, see <i>Breeding</i> .		
Meteorological Office, supply of harvest weather forecasts in 1915 ...	...	178
Mice, destruction ...	...	1163
Middlebrook, W. J. : Pollination of fruit trees : observations and experiments from 1904 to 1912 ...	...	418
Middleton, T. H. : Paper read to agricultural section of British Association ...	...	520
Middlings, utilisation for feeding purposes ...	...	300
Milk, see <i>Dairying</i> .		
Millet, growth (<i>Chelmsford</i>) ...	...	265
Morden Hall, chicken rearing demonstration, 1913-14 ...	...	10
" " egg-laying demonstration, 1914-15 ...	...	331
Motor ploughs, tractors, and disc harrows ...	34, 413, 570, 760, 784, 787	
Mussels as manure ...	...	156
Mustard, brown, growth ...	...	26, 1134
" " white ...	...	25, 454, 1134
Mutton, see <i>Meat</i> .		
National Insurance Act, 1911, regulations ...	...	700
Niger seed and cake ...	...	874
Northbrook, Lord, speech at food supply meeting ...	...	502
Northern Utility Poultry Society egg-laying competition ...	...	658
Oats (see also <i>Corn and Crops</i>) :		
Acreage and produce in 1914 ...	...	99
1915 ...	...	701, 817, 1189
Identification of the country of origin (<i>Cirencester</i>) ...	...	165
Manuring (<i>Rothamsted</i>) ...	...	356
" " in spring of 1916 ...	...	1275
Prices of British oats, averages ...	...	262
Rate of seeding (<i>Harper Adams</i>) ...	...	70
Varieties (<i>Chelmsford</i>) ...	...	1019
(<i>Edinburgh</i>) ...	...	<i>b</i>

Oats (see also <i>Corn and Crops</i>)—continued—						PAGE
Varieties, (<i>Glasgow</i>)	...	...	...	...	...	1300
" (<i>Harper Adams</i>)	...	...	...	...	...	262
" (<i>Midland</i>)	...	...	...	...	...	1300
" (<i>Woburn</i>)	...	...	...	...	...	356
Winter oats, varieties and growth	...	...	...	...	...	582
" varieties (<i>Leeds</i>)	...	...	...	...	...	808
Onion flavour, removal from milk (<i>U.S.</i>)	...	...	...	...	...	268
Orchards, see <i>Fruit</i> .						
Orwin, C. S. and Orr, J. : The cultivation of sugar beet in the West of England	...	...	...	...	...	210
Packing of produce for sale, suggested methods	...	...	...	...	...	201, 781
Palm-nut kernel cake, use as a feeding stuff	...	...	...	...	...	305, 738, 998
Panama-Pacific International Exhibition, 1915, live stock section	...	...	...	...	...	283
Pasteurisation, see <i>Bacteriology</i> .						
Pasture (see also <i>Hay and Crops</i> ; also <i>Clover</i> , <i>Lucerne</i> , <i>Rye-grass</i> and other specific plants):						
Basic slag	...	...	...	...	...	1013
Breaking up grass land	...	...	...	...	...	550
Clover and grass mixtures (<i>Woburn</i>)	...	...	...	...	...	356
Common, grazing in	...	...	...	...	...	1291
Farm seeds, report on quality, 1912-14	...	...	...	...	...	1041
Feeding value of various species of grasses (<i>Germany</i>)	...	...	...	...	...	1304
Improvement of leys	...	...	...	...	...	1107
Liming (<i>Harper Adams</i>)	...	...	...	...	...	264
Maiden seeds	...	...	...	...	...	453
Manures, action on different types of grass land	...	...	...	...	...	161
Manuring (<i>Harper Adams</i>)	...	...	...	...	...	263
" (<i>Northants C. C.</i>)	...	...	...	...	...	161
" of grass land	...	...	...	...	...	542, 1262
" of meadow land, influence on crop and soil (<i>Garforth</i>)	...	...	...	...	...	1176
" of poor meadow land (<i>E. Suffolk C. C.</i>)	...	...	...	...	...	162
" for meat and milk (<i>Harper Adams</i>)	...	...	...	...	...	262
" for mutton (<i>E. Suffolk C. C.</i>)	...	...	...	...	...	161
Meat production on grass land	...	...	...	...	...	521
Milk production on grass of good quality	...	...	...	...	...	524
Phosphatic manuring, accumulated fertility in consequence of	...	...	...	...	...	1201
Seed testing, facilities in England and Wales	...	...	...	...	...	1055
Toxic effect of grass round young trees	...	...	...	...	...	1178
Upland grazings, methods of improvement	...	...	...	...	...	1176
Wire fencing, and the enclosing of Downs	...	...	...	...	...	721
Paynter, F. G. : Chicken rearing at Morden Hall, 1913-14	...	...	...	...	...	10
Egg production at Morden Hall, 1914-15	...	...	...	...	...	331
Pears, see <i>Fruit</i> .						
Peas : Acreage and produce in 1914	...	...	...	...	...	90
" 1915	...	...	...	...	...	817, 1189
Growth	...	...	...	...	...	29
Manuring	...	...	...	...	...	1271
Varieties (<i>Chelmsford</i>)	...	...	...	...	...	266
Peat, analysis and ability to grow certain crops (<i>Ireland</i>)	...	...	...	...	...	897
" bacterised, as manure (<i>Midland</i>)	...	...	...	...	...	1297
" moss litter manure (<i>Germany</i>)	...	...	...	...	...	158
" inoculation of crops with a preparation of (<i>Woburn</i>)	...	...	...	...	...	464
Pegler, H. S. H. : The goat as a source of milk	...	...	...	...	...	642
Perry, see <i>Fruit</i> —Pears.						
Petherbridge, F. R. : Experiments on American gooseberry mildew in Cambridgeshire	...	...	...	...	...	227
Petre, Colonel : Experiments in crossing black currants and pears	...	...	...	...	...	232
Phosphate, see <i>Feeding and Feeding Stuffs</i> and <i>Manures</i> .						
Pigeon breeding for utility purposes	...	...	...	...	...	335
Destruction of wood pigeons	...	...	...	...	...	1164
Pigs, see <i>Live Stock</i> .						
Plant Diseases, see <i>Diseases of Plants</i> .						
Ploughing up grass land to increase the food supply	...	...	...	...	...	550
" with motor ploughs and motor tractors	...	...	...	...	...	34, 413, 570, 760, 784
Plums, see <i>Fruit</i> .						
Poisoning of stock by castor oil seeds (<i>Germany</i>)	...	...	...	...	...	359

	PAGE
Pollination, see <i>Fruit and Hops</i> .	
Potash, see <i>Manures</i> .	
Potatoes (see also <i>Fungi, Spraying, Insects, Import Regulations and Crops</i>):	
Acreage and produce in 1914 ...	90
" 1915 ...	701, 910, 1189
Cultivation, various methods (<i>Ireland</i>) ...	260
Manuring ...	1271
" (<i>Lindsey C. C.</i>) ...	239
" (<i>Northants C. C.</i>) ...	259
" (<i>Rothamsted</i>) ...	358
Old potatoes, consumption in preference to new ...	371
Seed, growing by means of mulching (<i>U.S.</i>) ...	1136
" ripe <i>v.</i> unripe (<i>Midland and Australia</i>) ...	1299, 1300
" sprouted <i>v.</i> unsprouted (<i>Dorset C. C.</i>) ...	1299
" trials of change of source (<i>Chelmsford</i>) ...	259
Tops, use as fodder ...	454
Varieties (<i>Chelmsford</i>) ...	100
" (<i>Dorset C. C.</i>) ...	1299
" (<i>Edinburgh</i>) ...	1298
" (<i>Lindsey C. C.</i>) ...	160
" (<i>Midland</i>) ...	1299
" (<i>Northants C. C.</i>) ...	160
" suitable for planting in areas infected by wart disease ...	813
Poultry: <i>Acornis</i> , bad effect on laying hens (<i>Germany</i>) ...	902
Breeding stock, selection of suitable birds ...	877
Calico poultry-houses ...	969, 1140
Chicken rearing at Morden Hall, 1913-14 ...	10
Chickens, hints on hatching ...	879
" increase in numbers and quality ...	1293
" precautions for safety when received by post or rail ...	1147
" rearing and feeding ...	1139
Co-operative methods in poultry keeping ...	326
Development Commissioners' report for 1914-15 on grants ...	1174
Eggs: Bacterial content (<i>U.S.</i>) ...	167
Collection for wounded soldiers ...	176, 699
Description as fresh and new laid ...	590
Laying competition at Burnley ...	658
" competitions of the Harper Adams College and the Utility Poultry Club ...	594, 808, 1306
Precautions for safety when received by post or rail for hatching ...	1148
Production at Morden Hall, 1914-15 ...	331
Sittings of eggs of pure breeds, Board's scheme for distributing ...	812
Supply, suggestions for increasing ...	461
" Variations in physical characteristics (<i>U.S.</i>) ...	901
Foxes, need for destruction ...	815, 1165
Italian geese ...	791
Local restrictions under Public Health Act, 1875 ...	1021
Quills of geese, turkeys and ducks, supply during the war ...	690
Report on the poultry industry in Wales. <i>Journal</i> supplement ...	694
Roman geese ...	791
Short course in poultry management at South Eastern Agricultural College ...	475
Stubbles, use for feeding poultry ...	678
Tubercular fowls, how they infect pigs ...	41
Tumours in fowls (<i>U.S.</i>) ...	1306
Women, education and openings in poultry work ...	633
Belgium, poultry keeping at Lippeloo ...	329
Denmark, progress of the poultry industry ...	129
Prices (see also <i>Agricultural Statistics</i>):	
Agricultural produce, prices and supplies in 1914 ...	511, 906
Corn prices, annual averages, 1909-1913 ...	1037
Feeding stuffs, prices and unit values ...	52, 148, 248, 322, 456, 574, 680, 792
	887, 1001, 1149, 1276
Imports prices ...	996
Index number of prices of agricultural produce ...	911
Special Enquiries Branch, report on first twelve months of war ...	833
Pulse, see <i>Beans and Peas</i> .	
Punjab, see <i>India</i> .	
Quills, supply during the war ...	690

	PAGE
Rabbit breeding on small holdings	140
Rabbits, destruction	1165
Radio-active substances as fertilisers (<i>U. S. and Germany</i>)	68, 354, 806
Railway transport of agricultural produce	177, 781, 811, 1206
Rape, growth	26, 27
Rats, destruction	87, 1192, 1238
Reclamation and improvement of land : Allotments	958
Bog land, use for growing certain crops (<i>Ireland</i>)	897
Croydon Vacant Lands Cultivation Society	963
Development Commissioners' report for 1914-15 on grants	1175
War food societies	497, 894, 909
Wire fencing on down grazings	721
Reenrolling of agricultural workers, see <i>War and Agriculture</i> .	
Reeds, use as fodder	454
Rennet, preparation of home-made extract	241
Research : Development Commissioners' report for 1914-15	1172
Grants for agricultural education and research, regulations for 1915	16
" " " " " report for 1914-15	708
Institutes for research in various subjects	39
Rew, R. H. : Presidential address to agricultural section of British Association, 1915	504
Rhodesia, see <i>South Africa</i> .	
Rice flour, use for making bread (<i>France</i>)	465
" meal, use for feeding purposes	303
Robertson, G. S. : New feeding stuffs	871
Robinson, G. W. : Soils and agriculture of North Wales	216
Roman or Italian geese	791
Rooks, destruction	1293
Root crops, see specific crops.	
Rotation of crops : Bare fallows, need for reducing	1282
Continuous green cropping	31, 266
Manuring and rotation of crops (<i>E. Suffolk C. C.</i>)	234
Suggestions for improving Welsh rotations	1107
Rothamsted Experimental Station : Monthly notes on fertilisers	1156, 1281
Russell, E. J. : How can crops be grown without potash manures ?	393
On growing two white-straw crops in succession	533
Soil analysis	116
Rye : Acreage and produce in 1914...	90
" " " 1915...	1189
Growth of	24, 27
Rye-grass, excessive use in "seeds" mixture	1112
" growth of Italian	25
" report on quality of Italian and perennial rye-grass, 1912-1914	1050
" varieties (<i>Woburn</i>)	357
Sadler, W. : Clotted cream	105
Safflower seed and cake	875
Sainfoin, report on quality of seed, 1912-1914	1049
Sale of Food and Drugs Acts, circular letter as to hardships in sale of milk	908
Salmon, E. S. : A new variety of hop—the "Foundling"	136
A new fungicide for use against American gooseberry-mildew	1118
Salt as a substitute for potash	68, 400
San Francisco, Panama-Pacific international exhibition, 1915	283
Sankey, G. C. : The use of stubbles for poultry	678
Saw-mill waste as a source of potash	146
Scotland : Area under crops, 1915...	468
Committee on home production of food	586
Number of live stock, 1915	467
Seed testing station at Edinburgh	281
Seaweed, composition and manurial and feeding values	1095
" cultivation in Ireland for manure	462
Seeds (see also <i>Weeds and Import Regulations</i>) :	
Barley seed, conditions affecting germination	313
Clustered clover seed as an adulterant of white clover seed	253
Farn seeds, report on quality, 1912-1914	1041
Germination, method of testing	364
Railway transport	1260
Scottish seed-testing station	281
Testing of seeds, facilities in England and Wales...	1055, 1290

Seeds (see also <i>Weeds and Import Regulations</i>)—continued—		PAGE
White clover seed, adulteration	...	253, 997
France, establishment of a plant diseases branch of Ministry of Agriculture	...	476
Selborne, Lord: Speech at food supply meeting	...	489
Selling by co-operative methods, suggestions from America	...	201, 370
Serum injection for treatment of swine fever	...	594, 691, 702
Sesame seed and cake	...	871
Sewage sludge as manure	...	235
Sharps, use for feeding purposes	...	300
Sheep, see <i>Livestock</i> .		
Shows, see <i>Exhibitions</i> .		
Sludge, see <i>Ensilage</i> .		
Slaughter of animals order of 1915	...	182, 370, 468, 469, 702
Small holdings and allotments (see also <i>Poultry</i> , <i>Co-operation</i> and specific crop):		
Allotments, methods for improvement	...	958
" report on, 1914	...	281
Co-operative farm implement societies	...	413, 570, 784
Croydon vacant lands cultivation society	...	963
Fruit preserving for small market growers or for domestic use	...	447
Fruit pulp, making of	...	450
Increase of food production, President's circular letter	...	1011
Land settlement for discharged sailors and soldiers	469, 813, 1166, 1188	
Manuring of cottage gardens and allotments	...	1270
Pigeon breeding	...	335
Progress of small holdings movement	...	73
Rabbit breeding on small holdings	...	140
War food societies	...	407, 894, 909
Women, education and openings in horticulture and agriculture	...	554, 616
Smoke, effect on plant growth (<i>Leeds</i>)	...	168
Sodium compounds, use for liberating potash contained in the soil	68, 400, 402	
Soils: Acidity, testing with litmus paper (<i>Canada</i>)	...	1298
Analysis of soils, values and difficulties	...	116
Atmosphere of the soil	...	352
Humus, soluble, effect on productiveness of soil	...	1298
Lime, application to soil rich in magnesia (<i>Woburn</i>)	...	353
" for sterilising and neutralising soils	...	255, 353
North Wales, soils and agriculture	...	216
Peat, inoculation of crops with a preparation of (<i>Midland</i>)	...	1297
(" <i>Woburn</i>)	...	464
Potash in the soil, methods of rendering available	...	400
Sterilisation by steaming (<i>U.S.</i>)	...	807
" partial, by antisepsics	...	158
Somerville, W.: Accumulated fertility in grass land in consequence of phosphatic manuring: second report on experiments	...	1201
Wire fencing	...	721
Sorghum, growth and utilisation	...	28, 155, 265
South Africa: Inoculation of cattle in Rhodesia against the planoscs	...	476
Land and agricultural bank	...	365
South Eastern Agricultural College, short course in poultry management	...	475
Soya bean, growth and use for feeding purposes	...	304, 1286
Sparrows, destruction	...	1164
Special Enquiries Branch, report for first 12 months of war	...	833
Spinks, G. T.: Experiments on American gooseberry-mildew in Cambridgeshire	...	227
Spraying: American gooseberry-mildew, spraying against	227, 364, 1118, 1244	
Ammonium sulphide solution, use against American gooseberry-mildew	...	1118
Apple scab, spraying v. dusting against (<i>U.S.</i>)	...	270
Bordeaux mixture	...	71, 72, 269, 270
Burgundy mixture	...	269, 270
Dusting v. spraying (<i>Ireland</i>)	...	270
(" <i>U.S.</i>)	...	270
Hop mildew, spraying against	...	1119
Lime-sulphur wash	...	1118
Lime washes, methods of use and value	...	1125
Liver-of-sulphur solution	...	1120, 1244

Spraying— <i>continued</i> —	PAGE
Potato blight, spraying against (<i>Ireland</i>)	259, 270
Potato spraying with Bordeaux paste and Bordeaux mixture (<i>Woburn</i>)	72
Winter spraying of fruit trees	901
Stapledon, R. G. : Some methods of adding to our food supplies	1107
Statistics, see <i>Agricultural Returns and Statistics</i> .	
Sterilisation, see <i>Soils, Seeds, Bacteriology, Pasteurisation, and Dairying</i> .	
Straw : Composition and digestibility (<i>Germany</i>)	900
Growth of two white straw crops in succession	533
Effect on the utilisation of nitrogen in farmyard manure	157
Use as fodder	453, 663, 1303
Strawberries, see <i>Fruit</i> .	
Sugar beet (see also <i>Crops</i>) :	
Cultivation in the West of England	210
Feeding and manurial value of crowns and leaves	750
Growth	1210
Sulphate of ammonia, see <i>Manures</i> .	
Sulphur as manure	354
Supplement to the <i>Journal</i> : Report on the poultry industry in Wales	694
Swedes :	
Acreage and produce in 1914	90
1915	701, 910, 1189
Manuring (<i>Aberystwyth</i>)	259
" (<i>Hereford Educ. Com.</i>)	257
" (<i>Northants C. C.</i>)	258
Time of sowing (<i>Chelmsford</i>)	266
Swine, see <i>Live Stock</i> .	
Threshing with the aid of a motor tractor	573
Timber, see <i>Forestry</i> .	
Timothy grass, report on quality of seed, 1912-14	1052
Tithe, etc., Acts, report of proceedings under, 1914	281
maps, alteration in facilities for examination	1019
Tobacco :	
Development Commissioners' report for 1914-15 on grants	1174
Growth (<i>Ir. land</i>)	264
Tractors, motor, for ploughing and other work	34, 413, 570, 760, 784
Transport by rail of agricultural produce	177, 781, 811, 1260
Trefoil, report on quality of seed, 1912-14	1049
Tropical agriculture and the International Institute of Agriculture	65
Tuberculosis, see <i>Diseases of Animals</i> .	
Turnips :	
Acreage and produce in 1914	90
1915	701, 910, 1189
Hardy green turnips, growth	27
Manuring (<i>Ireland</i>)	258
Twine, binder, transport by rail	177
United States :	
Co-operative methods of marketing produce	291, 370
Fruit growers' association at Watheana	367
Panama-Pacific international exhibition, 1915, live stock section	283
Utility Poultry Club's egg-laying competitions at Harper Adams College	594, 808, 1306
Valuation of farm stock for book-keeping purposes	1215
Vegetables, see specific crops.	
Vermi, destruction on farms	87, 815, 1162, 1238
Vetches, growth	30
Veterinary science, etc., see <i>Diseases of Animals</i> .	
Vickers, V. R. S. : Successful employment of women on a farm	1006
Village war food societies	407, 894, 909
Waddingham, J. H. : Some Irish larch plantations	231
Wagons, see <i>Labour</i> .	
Wales, North, soils and agriculture	216
Suggestions for increasing the production of food in	1262
Walker, Colonel Hall, purchase of stud by the Government	911
Wallace, R. : Karakul sheep	434

War and agriculture (see also specific subject):	PAGE
Agricultural consultative committee	178
workers and enlistment	87, 809, 903, 905, 1013, 1015, 1181
Allotments, President's circular letter as to increase of food production	1011
Animals, production and slaughter	182
Breaking up grass land	550
Chickens, increase in numbers and quality	1293
Crop returns, avoidance of delay	275
Crops, maximum production	182
Egg collection for wounded soldiers	176, 690
supply, suggestions for increasing	461
Ensilage, special notice to farmers	372
Feeding stuffs, influence of the war on supplies and use	737
Food supply: Bare fallows, reduction in	1292
Croydon Vacant Lands Cultivation Society	963
Economy in food	533
Home production, assistance by children	905
circular letters as to need for increase	816, 1183
committees on	370, 494, 585, 803
Improvement of allotments	958
Suggestions for increasing	1107, 1262
Supplies and production, addresses at British Association, 1915-1916	529
Supply meeting, Lord Selborne's and other speeches	489
Slaughter of pigs to prevent spread of swine fever reduced	702
War food societies	497, 894, 909
Germany, action taken to conserve food supply	741
Hay for the Army	183, 471
Hay-making, employment of soldiers	371
Horses, committee on supply for military purposes	590, 1022, 1253
Labour, assistance by soldiers	696, 1148
shortage owing to the war, and measures taken	178, 179, 170, 907
suggestions for saving	33, 653
Land settlement for discharged soldiers and sailors	469, 813, 1166, 1188
Lights, carrying at night on farms	1309
Live stock returns, avoidance of delay	275
Maintenance of Live Stock Act, 1915	468
Order, 1915	1018
Mares for breeding, sale after use by the army	276
Meat supply, maintenance	275
Military Service Act, 1916, notice to farmers	1181
Milk production	981
Parasitic mange amongst east Army horses, circular letter	700
Potash, methods of remedying shortage caused by the war	146, 393, 614, 766
Potatoes, consumption of old tubers in preference to new	371
Selborne, Lord, appeal to farmers in England and Wales	670
Sheep grazing on golf links	177, 373
Slaughter of Animals	370, 468, 469, 702
Special Enquiries Branch, report on first twelve months of war	833
Spread of disease from Army horses to agricultural horses	1188
Sulphate of ammonia, need for increased purchase by farmers	1180, 1207, 1309
Transport by rail, notice as to delays	177, 811
Wages of agricultural labourers, increase in	374
War agricultural committees	702, 861, 907, 1013, 1015, 1188
food societies	407, 894, 909
Wheat, regulation of export from India to Great Britain	180, 372
Women, notices as to war work	472, 474
work in agriculture in peace and war	554, 616, 859, 929, 1006, 1180, 1312
Waste land, reclamation and improvement, see <i>Reclamation and Improvement of Land</i> .	
Bracken, use as litter	689, 690
Farm seeds, report on quality, 1912-1914	1041
Feeding value of certain species (Germany)	362
Identification of the country of origin of oats by means of the weed species contained (<i>Circest r</i>)	165
Manurial value of certain species (Germany)	362
Medicinal plants, collection and sale in England	62
Need for destruction	1061
Scottish seed testing station	281

		PAGE
Weeds (see also <i>Seeds</i>):		
Seed-testing facilities in England and Wales	...	1055, 1290
Toxic effect of weeds round young trees	...	1178
<i>Canada</i> , weed control acts and methods	...	184
Cultivation of medicinal plants	...	913
Welsh, J. W. : The Hitchin bacon factory	...	317
Western wools grass, growth	...	25
Westmorland and Cumberland travelling butter-making school	...	1008
Wheat (see also <i>Corn</i> and <i>Crops</i>):		
Acreage and produce in 1914	...	90
1915	...	701, 817, 1189
Autumn wheat, manuring in spring of 1916	...	1274
"Benefactor" variety of wheat	...	807, 1009
Composition of wheat and its by-products (<i>Ireland</i>)	...	260
Continuous growth (<i>Rotkamstet</i>)	...	535
Copper salts, influence on growth (<i>Woburn</i>)	...	464
Green manuring (<i>Woburn</i>)	...	353
Growth of two white-straw crops in succession	...	533
Imports	...	579
Lead salts, influence on growth (<i>Woburn</i>)	...	464
Manuring	...	540, 1274
Magnesia, influence on growth (<i>Woburn</i>)	...	464
Offals, utilisation for feeding purposes	...	297
Price during war, suggestions for a minimum	...	494, 585, 803
Prices of British wheat, averages	...	581, 1037
imported wheat, averages, 1913-1915	...	1037
Rate of seeding (<i>Harper Adams</i>)	...	261
Spring sowing, selection of suitable varieties	...	867
" wheat manuring in spring of 1916	...	1274
" " varieties (<i>Leeds</i>)	...	898
" " (<i>Midland</i>)	...	1300
Stubbles, use for feeding poultry	...	678
Threshing with the aid of a motor tractor	...	573
Top-dressing in autumn	...	777, 810
Varieties (<i>E. Suffolk</i>)...	...	69, 808
" (<i>Harper Adams</i>)	...	261
" (<i>Ireland</i>)	...	69
" (<i>Leeds</i>)	...	807, 1009
" (<i>Northants</i>)	...	69
" (<i>Salop C. C.</i>)	...	1010
" (<i>Woburn</i>)	...	898
from Egypt, suitability for export to England	...	261
Winter wheat varieties (<i>Chelmsford</i>)	...	69
<i>India</i> , regulation of the exportation of wheat to Great Britain	180, 372, 1013	
Wibberley, T. : Co-operative farm implement societies	...	413, 570, 784
Wilkins, Mrs. R. : The work of educated women in horticulture and agriculture		
culture	...	554, 616
Willow-growing and basket-making	...	1081
Wilson, P. E. : Rabbit breeding on small holdings	...	140
Wire fencing	...	721
Women, education and openings in horticulture and agriculture	...	554, 616
" notices as to war work	...	472, 474
" work in agriculture in peace and war	...	859, 929, 1006, 1180, 1300
Woods, see <i>Forestry</i>		
Woodpeckers and their relation to forestry	...	789
Wood pigeons, destruction	...	1164
Wyllie, J. : Farm valuations for book-keeping purposes	...	1215
Yeast, dried, as food for farm stock	...	1, 302, 740

